UNIVERSITY OF EDINBURGH

THESIS

entitled

"A STUDY OF THE INSECTS OF UPLAND PASTURES"

Submitted
by

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INTRODUCTION

Studies of the insects of permanent pasture land have been much less extensive than those of rotational crops. This is largely due to the fact that on average, major pest outbreaks are much less liable to cause severe losses in the relatively stable environment of grassland than in the more changeable conditions of arable fields. There has, to my knowledge, been no continuous record kept for a year or more of the occurrence of insects of permanent pasture land in south east Scotland and records of similar work in other parts of the world are not very extensive. In view of the great and increasing importance of grass in Scottish agriculture (out of a total of 15,344,266 acres of agricultural land no less than 13,733,434 acres are under grass) and it is considered desirable that a better knowledge of pasture insects as a whole should be obtained.

PREVIOUS WORK

Previous investigations of pasture insects by individual workers have often been restricted either to insects occurring in the soil or to those above the soil. A few have dealt with both habitats.

Among those dealing with soil fauna investigation, the work of McAtee (1907) is probably the earliest worth mentioning. He studied the total fauna of four square feet of meadow land in Washington. Cameron (1913, 1917) made a general survey of the insect soil fauna in a field near Manchester and later compared that with one in Cheshire. Buckle (1912) carried out a survey of the soil fauna in three types of agricultural land near Manchester (a) land continuously under plough for a number of years (b) land which had been ploughed from pasture not less than three years previously and (c) permanent pasture land, this providing a control to the conditions on the arable land and giving some indication of the seasonal variation in the environment. His samples were of nine inch cubes of soil from each of these plots. He later (1923) continued his investigation on four different types of land (i) permanent pasture (ii) permanent meadow land (iii) recently ploughed pasture and (iv) rotational arable; he found that the insect fauna did not differ very much on the different types of pasture land. Morris (1922b and 1927) studied the soil fauna of manured as against unmanured plots of arable land at Rothamsted and later extended his work to the observation of insect species in five plots receiving

different/

different manurial treatments with an unmanured plot as control. Thompson (1924) compared the macroscopic soil fauna of permanent pasture with that of land recently brought under cultivation at Aberystwyth. She observed not only the species occurring but also their relative numbers and also divided the nine inch cube samples into three horizontal sub-samples each of three inches. As has been found by other workers, she collected the bulk of the insects from the surface three inches. Edwards (1929) carried out a survey of insects and other inveterate fauna also at Aberystwyth. He made censuses on light alluvial pasture, light drift pasture, light drift arable, boulder clay pasture and sedimentary pasture. Like Thompson he divided his samples horizontally, but into four sub-samples keeping the surface inch separate from the next two. He found little difference in the fauna of the different pastures and the highest population in the surface inch.

Wolcott (1937) collected a hundred soil samples each of one foot cube between April and October 1919. 51 of these samples were from meadow land, 18 from pasture with abundant vegetation and the remaining 31 from pasture of scanty vegetation.

The animals in the samples were anaesthetised and were hand picked from the soil. Strickland (1947 1945a) compared the faunas of two plots in Trinidad, one a savannah plot and one in a cacao plantation. He took samples in the form of cores 3.6 inches in diameter and to a depth of three inches divided horizontally /

horizontally into two equal sub-samples. The fauna was extracted by Berlese-Tullgren funnels. He did not find marked differences between the two plots and results showed certain similarities to those from English pastures. The work by Salt, Hollick et al. (1944, 1946, 1948) on the extraction of wireworms from soil is almost too well known to require mention. Their samples were cores four inches in diameter taken to a depth of six and twelve inches. Extraction was by floatation of the sample in a solution of magnesium sulphate of specific gravity 1.2 and subsequent separation by the use of benzene or tuluene. This is the method of soil examination which recovers a higher percentage of the fauna than any other but has disadvantages, in that all the specimens are wetted with the solution used and the machine commonly employed damages more fragile insects. It is excellent for the extraction of larval forms but the impossibility of determining these in many instances detracts somewhat from this advantage. The method was used very extensively during and just after the Second World War in wireworm survey work in many areas in Britain. Salt (1952) also examined samples from tropical Africa and in these he found only about half the total number of insects obtained from English soils.

Among those workers who have investigated the fauna of pasture herbage, I would mention Miles (1921) who compared those insects which fed on grasses and allied plants during summer with those which used the herbage for shelter in winter. Lever (1937) made an ecological study of the fauna of grass plains in the Southern Solomon Islands. The area was dominated /

dominated by Themeda australis and Imperata cylindrica and his study extended to all animals occurring there including the vertebrates. Osborn (1939) compiled a list of insects of meadow and pasture land of different parts of America including his own collections, which were made over many years while working at the Ohio State University. His list included over 650 species. Cumber (1958), (1959a to f, 1960 a and b) and Cumber and Harrison (1959) made an extensive survey of the insects of certain sown pastures in the north island of New Zealand. Their collections were made by the use of sweep nets.

Of those workers who examined the soil fauna along with that of the herbage, I would mention two. Morris (1920) carried out an investigation for one year of a permanent pasture field which he considered to be typical of such land in Cheshire. His soil samples were ten inches square and one foot deep, divided into horizontal sub-samples each of two inches depth. The removal of the insects was by hand-picking in the laboratory. He also collected insects by the use of a sweep net. He found that relatively few insects occurred at a greater depth than two inches and none below six inches even during winter time.

Ford (1935) made qualitative and quantitative censuses of the animals occurring both in the soil and on the vegetation of a meadow near Oxford. His soil samples were three inches square and nine inches deep and his vegetation samples were taken from six inch squares. He extracted the fauna by the use of Berlese's funnel. His findings indicated that the greatest /

greatest concentration of insects occurred between one and one and a half inches below the surface. He found few below four and a half inches and none below eight inches.

The findings of previous workers with regard to the species collected, are not dealt with here as they will be mentioned in the discussion which follows the results section of the thesis.

SITE OF THE PRESENT INVESTIGATION

The present investigation was made on "Marginal" and Hill pastures on two farms of The Edinburgh School of Agriculture. Two fields which had at some time been ploughed were selected and the fauna of these compared with that of neighbouring hill land which had not been ploughed within the memory of man. As it happened, the fields belong to different farms although they were almost contiguous.

The field of Leips* on Boghall farm is approximately four acres of sloping ground between 850 and 950 feet above sea level. It was broken from hill land first in 1940 in which year it was ploughed and resown directly. It was again ploughed in 1948 when it was sown out under an oat crop. It was ploughed again for a potato crop in 1955 and was resown in 1956. This field is relatively clear of weeds, the grass is well grazed and fairly uniform.

The field of upper Fulford† on Easter Howgate farm extends to about ten acres, is at the same elevation as Leips, but has not been ploughed for about 25 years. The herbage here is, as might be expected more weedy than on Leips.

For comparison with results from these two fields, samples were also taken from the neighbouring hill land on the two farms.

For convenience in recording during the investigation, the fenced fields were referred to by the abbreviation C.P.L. (cultivated pasture land) and the hill land P.P.L. (permanent pasture land) to which initials B.H. and H.G. were added indicating /

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* Photograph A. † Photograph B.

Ea/ indicating Boghall or Wester Howgate farms. It is proposed to use these abbreviations in this thesis.

A botanical survey of the plants growing on the four experimental areas was made by removing to the laboratory plants from each of these areas. The plants were identified for me by the Botanical Department of The School of Agriculture as follows:-

A. I Leips Field Boghall (CPL/BH)

1. Soft Rush - Juncus effusus
2. Spear Thistle - Cirsium lanceolatum
3. Perennial Nettle - Urtica dioica
4. Creeping Buttercup - Ranunculus repens
5. Creeping Thistle - Cirsium arvense
6. Perennial Ryegrass - Lolium perenne
7. Cocksfoot - Dactylis glomerata
8. Italian Ryegrass - Lolium multiflorium
9. Yorkshire Fog - Holcus lanatus
10. Tufted Hairgrass - Deschampsia caespitosa
11. Common Bent - Agrostis tenuis
12. Spear Thistle - Cirsium vulgare
13. Wild White Clover - Trifolium repens

A. II Boghall - Hill Land (PPL/BH)

1. Soft Rush - Juncus effusus
2. Bracken - Pteridium aquilinum
3. Yarrow - Achillea millefolium
4. Gorse - Ulex europaeus
5. Crested Dog's-tail - Cynosurus cristatus
6. Common Bent - Agrostis tenuis

7. Perennial Ryegrass - Lolium perenne
8. Heath Bedstraw - Galium hercynicum
9. Wild White Clover - Trifolium repens
10. Sheep's Fescue - Festuca ovina
11. Wavy Hair Grass - Deschampsia flexuosa
12. Tufted Hair Grass - Deschampsia caespitosa
13. Red Fescue - Festuca rubra
14. Sweet Vernal Grass - Anthoxanthum odoratum
15. Mouse-ear Chickweed - Cerastium arvense
16. Moor Mat Grass - Nardus sticta
17. Yorkshire Fog - Holcus lanatus
18. Smooth Stalked Meadow Grass - Poa pratensis

B. I. Howgate - Cultivated Pasture Land (CPL/HG)

1. Soft Rush - Juncus effusus
2. Creeping Thistle - Cirsium arvense
3. Spear Thistle - Cirsium lanceolatum
4. Cocksfoot - Dactylis glomerata
5. Sedge - Carex sp.
6. Common Bent Grass - Agrostis tenuis
7. Blaeberry - Vaccinium myrtillus
8. Sheep's Fescue - Festuca ovina
9. Perennial Ryegrass - Lolium perenne
10. Rough Stalked Meadow Grass - Poa trivalis
11. Creeping Buttercup - Ranunculus repens
12. Wild White Clover - Trifolium repens
13. Yorkshire Fog - Holcus lanatus
14. Timothy - Phleum pratense

B. II /

B. II Howgate - Hill Land (PPL/HG)

1. Blaeberry - Vaccinium myrtillus
2. Heather - Calluna vulgaris
3. Gorse - Ulex europaeus
4. Bracken - Pteridium aquilinum
5. Moor Mat Grass - Nardus stricta
6. Red Fescue - Festuca rubra
7. Wavy Hair Grass - Deschampsia flexuosa
8. Common Bent Grass - Agrostis tenuis
9. Sheep's Fescue - Festuca ovina
10. Heath Bed-straw - Galium hercynicum
11. Sedge - Carex sp.
12. Cross-leaved Heath - Erica tetralix
13. Sweet Vernal Grass - Anthoxanthum odoratum
14. Tormentil - Potentilla tormentil

Apart from these weeds and grasses, the following mosses were also abundently present in only the permanent pasture land of Howgate.

Howgate

1. Hypnum cupressiforme
2. Pleurozium schreberi
3. Polytrichum commune
4. Dicranum sesparium
5. Ephemera sp.

From the above list it is clear that as far as the grasses and weeds of the cultivated pasture land of Boghall and Howgate are concerned, there is not much difference. The cultivated /

cultivated pasture land of Boghall is a healthy perennial ryegrass dominant pasture. The cultivated pasture land of Howgate is getting past its best and is an old pasture of perennial rye-grass, cocksfoot and timothy mixture. In the permanent pasture lands of the two farms (PPL/HG and BH), there are a few more grasses at Boghall than at Howgate, but on the other hand the permanent pasture land of Howgate has a few more bushes and weeds. The most common are heather and blaeberry which were not found on the permanent pasture land under survey at Boghall. Similarly soft rush and yarrow are the few weeds of permanent pasture land on Boghall which are absent from the permanent pasture land under survey at Howgate.

The soil of Leips is derived from a fairly heavy boulder clay till of mixed origin, mainly andesites and rhyolites from local formations but with some admixture of carboniferous rocks and Old Red Sandstone. Its texture is sandy clay-loam to clay-loam and, despite recent cultivations, the top soil still contains quite a high level of organic matter. It is an imperfectly drained soil with a strong grey and brown mottling at a depth of 9" to 36". The present pH value is 5.5 to 6.0.

The lower part of Upper Fulford is similar in all respects to Leips. The upper part has been subjected to colluvial action and is more stony in character, the texture being loam to sandy clay-loam. The organic matter content is somewhat higher than in Leips, the drainage freer and the present pH value between 6 and 6.5.

METHOD AND TECHNIQUE

A. Collection of Samples

Insects were collected at intervals of approximately one week from October 1958 to September 1960. As collection by sweeping is not successful when the herbage is wet, the intervals between collections had to be varied slightly in accordance with weather conditions. Samples were taken from Boghall and Howgate on alternate visits.

A soil sample nine inches square by five inches deep was removed by an ordinary spade and transported to the laboratory in a vasculum having a tight fitting lid, care being taken not to damage the turf or disturb it more than necessary. The herbage fauna was sampled by the use of a sweep net, each sample representing the produce of sweeping for one hour, the net being emptied after about each 40-50 strokes. This method of sampling was adopted as being the most practicable in the circumstances although it has to be admitted that it has certain disadvantages (a) that the actual area sampled is not known (b) that it removes from the area a considerable number of insects which might have a slight effect on the fauna left (c) that it gives very large samples at certain seasons involving great labour in pinning, preserving and subsequent examination and (d) that some of the more fragile insects are damaged by the net, sometimes to the extent of rendering them unfit for identification, especially when the herbage is somewhat moist. There is also the fact that the insects caught will vary at least to some extent /

extent with the weather prevailing at the time of sweeping, as certain insects hide at the base of the herbage in cold and dull conditions. Despite these objections, however, it is felt that the results have justified the method in view of the large number of samples taken.

B. Examination of samples in the laboratory

The soil samples were treated as recommended by Tullgren (1917). The basic principle of the extraction method is that the soil, placed on a coarse sieve, is gradually desiccated by the heat of an electric lamp placed above so that the insects move down in front of the increasing desiccation until they pass through the sieve, from which they fall by way of a funnel into a tube containing a small quantity of 70 per cent alcohol. The details of the method as used in this work were: The soil sample was removed carefully from the vasculum, the herbage cut off by scissors to the surface of the soil and the turf placed upside down on the sieve of the apparatus, the dimensions and details of which are indicated by diagram A. It was found by experience that no further insects were recovered after a period of six days. Those insects which are usually keyed and described from dried specimens were removed from the spirit, pinned or carded as the case might be, and allowed to dry at air temperature. Those insects which are normally examined as slide preparations, e.g. Collembola, and Thysanoptera, were stored in spirit until required for examination.

The specimens obtained by sweeping were mounted for examination /

examination as is usual for their respective orders.

The amount of work involved in sampling and in the preparation and determination of the material did not allow time for breeding out individuals obtained in developmental stages, much as one would have liked to have attempted this. A number of species could, of course, be determined from their developmental forms but in only one case were larvae reared through to the adult stage for determination. This was in the case of the sawfly Pachynematus apicalis (Hart.), the rearing of which was continued through two generations to study its life history, time being available at this period.

Counts were made of the number of individuals of the various species obtained in each day's sampling. The results are set out in table I. In this table the convention has been adopted of entering the insects obtained from the "permanent pasture land" above the horizontal lines and those from the "cultivated pasture land" below the lines. The table shows the summed results of the corresponding months of the two years during which the collections were made (e.g. those collected in January 1959 have been added to those collected in January 1960). Where required for graphs, monthly entries are given in two forms. The upper entry shows the total number of individuals of the particular species obtained in the collections made during the respective month, the lower entry shows the average number of individuals obtained per sampling.

The technique of collection which had to be used in the time available resulted in damage to some specimens which made it /

it impossible to determine their species. There were also a number of developmental forms in which the species could not be determined. Specific determinations also proved impossible in the case of the Hymenoptera Parasitica. In all such cases, the individuals have been entered as "spp. indet." within their respective families. I have received much instruction and advice in making determinations and this is acknowledged later.

Where numbers of individuals within the species have been adequate, the occurrence of species through the year is shown graphically in figures 1 to 95 . Again in this connection the same convention has been adopted of placing the results from the "permanent pasture" above the horizontal axis of the graph and those from the "cultivated pasture" below, as if they were negative quantities.

The months have been indicated on the histograms by their initial letters. The letter T placed before the specific name on the graph indicates that all the individuals concerned were obtained by turf extraction, similarly the letter S by sweeping, while the letter B indicates specimens from both sources.

In the figures the names of the original describers of the species are omitted as these are included in Table I.

TABLE 1.

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
Number of Collections within the Months	4	8	4	3	3	7	5	5	6	6	7	6	64	
I DIPLURA														
1. Campodeidae														
										1	2	2	5	
Campodea staphylinus Westwood										0	0	0	0	1
II COLLEMBOLA														
1. Hypogastruridae														
	5	13	9	13	11	5	23	37	25	13	7	9	170	
Hypogastrura armata (Nic.)	7	11	15	11	22	11	14	41	19	5	4	3	163	1
	1.2	1.6	2.2	4.3	3.7	0.7	4.6	7.4	4.2	2.1	1.0	1.5		
	1.8	1.4	3.7	3.7	7.3	1.6	2.8	8.2	3.2	0.8	0.6	0.5		
2. Achorutidae														
	183	210	217	263	297	246	201	145	121	119	98	137	2237	
Friesea mirabilis (Tull.)	93	113	196	189	214	219	197	112	92	137	105	87	1754	2
	45.7	26.2	54.2	87.7	99.0	35.1	40.2	29.0	20.1	19.8	14.0	22.8		
	23.2	14.1	49.0	63.0	71.3	31.3	39.4	22.4	15.3	22.8	15.0	14.5		
3. Onychiuridae														
	390	460	617	549	497	521	593	496	423	407	379	361	5693	
Onychiurus armatus	279	309	504	413	387	403	521	396	371	294	273	259	4409	3
	97.5	57.5	154.2	183.0	165.7	74.4	118.6	99.2	70.5	67.8	54.1	60.2		
	69.7	38.6	126.0	137.7	129.0	57.6	104.2	79.2	61.8	49.0	39.0	43.2		

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
4. Isotomidae	97	101	157	148	194	188	141	149	157	131	109	91	1662	
Folsomia quadrioculata (Tull.)	82	114	129	159	160	173	126	97	99	86	98	76	1399	4
	24.2	12.6	39.2	49.3	64.7	26.8	28.2	29.8	26.1	21.8	15.6	15.2		
	20.5	14.2	32.2	53.0	53.3	24.7	25.2	19.4	16.5	14.3	14.0	12.7		
	17	4				2	9	19	27	24	33	35	170	
Isotoma viridis Bour.	9	0				7	4	21	14	28	29	29	141	5
	4.2	0.5				0.3	1.8	3.8	4.5	4.0	4.7	5.8		
	2.2	1.0				1.0	0.8	4.2	2.3	4.7	4.1	4.8		
	94	137	169	214	227	194	137	105	96	87	71	43	1578	
Osotoma violacea Tull.	78	94	145	163	204	216	174	136	121	79	69	39	1518	6
	23.5	17.1	42.2	71.3	75.7	27.7	27.4	21.0	16.0	14.5	10.1	7.2		
	19.5	11.7	36.2	54.3	68.0	30.9	34.8	27.2	20.2	13.2	9.8	6.5		
5. Entomobryidae	9						17	39	27	39	46	24	201	
Lepidocyrtus curvicollis Bour.	0						0	0	0	0	0	0	0	7
	2.2						3.4	7.8	4.5	6.5	6.6	4.0		
	0						0	0	0	0	0	0		
	1						2		14	13	5	4	39	
Lepidocyrtus cyaneus Tull.	0						0		0	0	0	0	0	8
	0.2						0.4		2.3	2.2	0.7	0.7		
	0						0		0	0	0	0		

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
	13						5	24	59	61	39	21	222	
Entomobrya nivalis Tull.	0						0	0	0	0	0	0	0	9
	3.2						1.0	4.8	9.8	10.1	5.6	3.5		
	0						0	0	0	0	0	0		
						2							2	
Orchesella sp.						0							0	
Pseudosinella alba (Pack.)									2	3			5	
									0	0			0	
Entomobrya albocincta (Temp.)												1	1	
												0	0	
6. Tomoceridae		0			1			3		1			5	
Tomocerus longicornis (Maller.)		1			0			0		0			1	
											2	1	3	
Tomocerus sp.											0	0	0	
7. Sminthuridae														
	11	4					5	14	12	11	16	6	79	
Sminthurinus niger (Lubb.)	9	6					4	9	13	9	14	9	73	10
	2.7	0.5					1.0	2.8	2.0	1.8	2.3	1.0		
	2.2	0.7					.8	1.8	2.2	1.5	2.0	1.5		

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
i/ Sminthurus viridés (Linn.)	46	16	9				3	45	129	114	98	113	573	11
	131	45	13				5	69	163	221	260	219	1126	
	11.5	2.0	2.2				.6	9.0	21.5	19.0	14.0	18.8		
	32.8	5.6	3.2				1.0	13.8	27.2	36.8	37.1	36.5		
III PLECOPTERA														
1. Nemouridae														
							1						1	
Protonemura meyeri (Picter.)							0						0	
							1						1	
Protonemura montana Kimm.							0						0	
2. Leuctridae														
							0					1	1	
Leuctra geniculata Steph.							1					0	1	
IV ORTHOPTERA														
1. Acrididae														
									2	1	8		11	
Omocestus viridulus (Linn.)									0	0	0		0	
V DERMAPTERA														
1. Forficulidae														
												2	2	
Forficula auricularia Linn.												0	0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
VI PSOCOPTERA														
1. Stenopsocidae	0												0	
Graphopsocus cruciatus (Linn.)	1												1	
2. Caeciliidae											0		0	
Philotarsus picicornis (Fab.)											1		1	
3. Pterodelidae												0	0	
Lachesilla pedicularia (Linn.)												1	1	
							1						1	
Psyllipsocus rumburi Selys.							0						0	
4. Atropidae												0	0	
Lepinotus patruelis Pearman												1	1	
5. Amphigerontidae										3			3	
Amphigerontia contaminata (Steph.)										0			0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
VII THYSANOPTERA														
1. Thripidae	12	15	17	21	26	31	29	26	24	33	21	23	278	12
Aptinothrips rufus (Gmelin)	9	11	10	16	11	17	21	23	10	13	14	10	165	
	3.0	1.9	4.2	7.0	8.7	4.4	5.8	5.2	4.0	5.7	3.0	3.8		
	2.2	1.4	2.2	5.3	3.7	2.4	4.2	4.6	1.7	2.2	2.0	1.7		
			2	2	1	3	2	4	3	4	5	1	27	13
Aptinothrips stylifer Trybom			0	1	2	3	4	0	2	4	1	1	18	
			0.5	0.7	0.3	0.4	0.4	0.8	0.5	0.7	0.7	0.2		
			0	0.3	0.7	0.4	0.8	0	0.3	0.7	0.1	0.2		
	2	1	2	0	1		3		2	0		3	14	14
Pseudoarticulella obscura (Miil.)	1	0	0	1	1		0		0	2		1	6	
		1							9	15	9	2	36	14
Limothrips cerealium Haliday		0							0	8	11	5	24	
		0.1							1.5	2.5	1.3	0.3		
		0							0	1.3	1.6	0.8		
								2	3		4	1	9	
Limothrips denticornis Haliday								0	1		5	0	6	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
								3	5	4	9	7	28	
Thrips fuscipennis Haliday								2	4	6	5	3	20	15
								.6	.8	.7	1.3	1.2		
								.4	.7	1.0	.7	.5		
									0	0			0	
Thrips angusticeps Uzel									3	2			5	
							4			2			6	
Platythrips tunicatus Haliday							0			0			0	
								4					4	
Odontothrips ulicis (Haliday)								0					0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
VIII HEMIPTERA														
HOMOPTERA - I														
1. Cercopidae														
	17	9								64	72	31	193	
Neophilaenus lineatus (Linn.)	2	3								9	11	4	29	16
	4.2	1.1								10.7	10.3	5.1		
	.5	.4								1.5	1.6	.7		
	11	2								18	27	20	78	
Neophilaenus exclamationis (Th.)	0	0								0	0	0	0	17
	2.7	0.2								3.0	3.9	3.3		
	0	0								0	0	0		
	12									41	41	8	102	
Philaenus leucophthalmus (Linn.)	2									3	2	0	7	18
	3.0									6.8	5.9	1.3		
	.5									.5	.3	0		
2. Bythoscopidae														
											0		0	
Oncopsis flavicollis (Linn.)											1		1	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
3. Ulopidae								1	1				2	
Ulopa reticulata (Fab.)								0	0				0	
4. Megophthalmidae											0		0	
Megophthalmus scanicus (Fall.)											1		1	
5. Delphacidae								1	9	0			10	
Delphacodes pellucida (Fab.)								1	2	1			4	19
								0.2	1.5	0				
								0.2	2.0	0.2				
							1		2				3	
Delphacodes denticauda Boh.							0		0				0	
								74	27				101	
Delphacodes discolor Boh.								0	27				27	20
								14.8	4.5					
								0	4.5					
Delphacodes elygantala Boh.									13	8			21	21
									0	2			2	
									2.2	1.3				
									0	0.3				

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig No.
								4					4	
Delphacodes sp. indet.								0					0	
								0					0	
Delphacodes forcipata Boh.								1					1	
								0	2				2	
Delphacodes obscurella Boh.								2	0				2	
											198	11	209	
Conomelus anceps (Germar)											12	0	12	
											28.3	1.8		22
											1.7	0		
									0				0	
Dicranotropis hamata (Boh.)									3				3	
									1				1	
Criomorphus albomarginatus (Curtis)									0				0	
6. Typhlocybidae	38	35	12	1		3	4	9	11		21	15	149	23
Dikraneura variata Hardy	9	4	5	0		0	0	0	0		3	7	28	
	9.5	4.4	3.0	.3		.4	.8	1.8	1.8		3.0	2.5		
	2.2	.5	1.2	0		0	0	0	0		.4	1.2		

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig No.
	1									0	2		3	
Ribamtiana ulmi (Linn.)	1									2	0		3	
											4		4	
Typhlocyba sp.											0		0	
										1	1	1	3	
Erythroneura alneti (Bahl.)										0	0	0	0	
7. Jassidae														
			1						1	2	7	3	14	24
Aphrodes albifrons (Linn.)			0						0	0	0	0	0	
			0.2						.2	.3	1.0	.5		
			0						0	0	0	0		
											0		0	
Aphrodes bicinctus (Schr.)											3		3	
									2				2	
Aphrodes bifasciatus (Linn.)									0				0	
	7							2	5	15	75	11	115	
Arocephalus punctum (Flor.)	0							0	0	0	10	0	10	25
	1.7							.4	.8	2.5	10.7	1.8		
	0							0	0	0	1.4	0		

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
									5	7	4	3	19	
Arthaldeus pascuellus (Fall.)									0	3	5	2	10	26
									.8	1.2	.6	.5		
									0	.5	.7	.3		
											0	0	0	
Cicadella aurata (Linn.)											15	8	23	27
											0	0		
											2.1	1.3		
												0	0	
Cicadella urticae (Fab.)												8	8	
										0	81		81	
Cicadula quadrinotata (Fab.)										1	0		1	28
										0	11.7			
										.2	0			
									7	32	119	49	207	
Deltocephalus pulicaris (Fall.)									0	18	60	16	104	29
									1.2	5.3	17.0	8.2		
									0	3.0	8.6	2.7		

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig No.
									16	11	9	8	44	
Diplocolenus abdominalis (Fab.)									15	7	0	1	23	30
									2.7	1.8	1.3	1.3		
									2.5	1.2	0	.2		
										5	23	14	42	
Elymana virescens (Fab.)										4	7	0	11	31
										.8	3.3	2.3		
										.6	1.0	0		
										3	5	8	8	
Errastunus ocellaris (Fall.)										0	0		0	
											4		4	
Euplix cuspidata											0		0	
											2	4	6	
Euscelis obsoletus (Kbm.)											5	0	5	
									1	2	6		9	
Euscelis plebeius (Fall.)									5	9	11		25	32
									.2	.3	.9			
									.8	1.5	1.5			

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig No.
	96	98	44	25	5	7	10	28	35	19	87	141	575	33
Hardya melanopsis (Hardy)	5	0	6	0	0	0	0	0	0	5	25	21	62	
	24.0	12.1	11.0	3.6	1.7	1.0	2.0	5.6	5.8	3.3	12.4	23.2		
	1.2	0	1.5	0	0	0	0	0	0	.8	3.6	3.5		
									0	11	1		12	34
Jassargus flori Fieb.									5	3	5		13	
									0	1.9	.1			
									.8	.5	.7			
	47								25	147	210	133	562	35
Jassargus pseudocellaris (Flor.)	0								2	7	25	41	75	
	11.7								4.2	27.5	30.0	22.2		
	0								.3	1.8	3.6	6.8		
	3								0	0	8	25	36	36
Macrosteles lacvis Ribant	45								53	170	123	75	366	
	.7								0	0	1.1	4.2		
	11.2								8.8	28.3	17.6	12.5		
												$\frac{1}{8}$	$\frac{1}{8}$	
Macrosteles viridigriseus Edwards														

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
	0										0		0	
Macrosteles sp.	3										5		8	
									0	0	0		0	
Psammotettix confinis (Dhlb.)									3	9	7		19	37
									0	0	0			
									.5	1.5	.3			
								56	31	3	7		97	38
Streptanus marginatus (Kbm.)								5	7	5	1		18	
								11.2	5.2	.5	1.0			
								1.0	1.2	.8	.1			
										0	9	7	16	
Streptanus sordidus (Zell.)										3	2	5	10	39
										0	1.3	1.2		
										.5	.3	.8		
									1				1	
Thamnotettix confinis (Zett.)									0				0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig No.
8. Coccidae					9	4					3		16	
Orthezia cataphracta (Shaw)					0	0					0			
	24	19	15	11	17	14	19	11	7	6	9	15	167	
Ripersia halophila (Hardy)	59	66	52	69	67	59	43	52	39	27	24	50	607	40
	6.0	2.4	3.7	3.7	5.7	2.0	3.8	2.2	1.2	1.0	1.3	2.5		
	14.7	8.3	13.0	23.0	22.3	8.4	8.6	10.4	6.5	4.5	3.5	8.3		
9. Liviidae						0			1				1	
Livia juncorum (Latr.)						1			0				1	
10. Psyllidae	3	1		6		0	0			1	3		14	
Psylla melanoneura (Först)	0	0		0		1	1			3	0		5	
11. Aphalaridae							2						2	
Aphalara exilis (Web. & Mohr.)							0						0	
								11	9	1			21	
Strophingia ericae (Curtis)								0	8	0			8	41
								2.2	1.5	.2				
								0	1.3	0				

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
12. Triozidae	10	2	2	1	3	4	0	8	4	0	2	0	36	42
Trioza albiventris (Forst.)	25	12	5	9	7	12	15	11	18	27	16	9	166	
	2.5	.2	.5	.3	1.0	.6	0	1.6	.8	0	0	0		
	6.2	1.5	1.2	3.3	2.3	1.7	3.0	2.2	3.0	4.5	2.3	1.5		
	2	1	0									1	4	43
Trioza urticae (Linn.)	6	7	1									4	18	
	.5	.1	0									.2		
	1.5	.8	.2									.6		
13. Aphididae														
Atheroides hirtellus Haliday													3	
Atheroides serrulatus Haliday													2	
Aphis fabae (Scop.)													13	
Acyrthosiphon pisum (Harris)													12	
Drepanosiphum platanoides (Sch.)													42	
Eriosoma lanigerum (Housm.)													1	
Eulachnus agilis (Kalt.)													4	

Species Collected		Total for 2 years
Elatobium abietina (Walker)		1
Holcaphis holci (Hardy)		12
Metopolophium festucae (Theo.)		442
Myzus persicae (Sal.)		11
Myzus ornatus Laing		3
Pentatrichopus fragaefolii Cock.		4
Byrsocrypta borealis (Tull.)		2
Rhopalosiphum padi (Sch.)		234
Rhopalosiphonimus cathae (Koch.)		1
Sitobion avenae (F.)		529
Sappaphis mali Ferr.		1
Sipha glyceriae (Kalt.)		12
Sipha schoutedeni Del Guerico		27
Spp. "Indet."		59

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
HETEROPTERA - II														
14. Nabidae	2										3	1	6	
Nabis flavomarginatus Scholtz	0										2	0	2	
15. Tingidae							0				0	0	0	
Tingis cardui (Linn.)							1				1	1	3	
							0						0	
Acalypta parvula (Fall.)							1						1	
16. Cimicidae											0		0	
Acompocoris pygmaeus (Fall.)											1		1	
Anthocoris nemoralis (Fab.)											1	0	1	
											0	2	2	
Anthocoris sp.										0	2	0	2	
										1	0	2	3	
Anthocoris confusus Reut.									0		0		0	
									2		1		3	
17. Saldidae											1		1	
Saldula orthochila											0		0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
18. Lygaeidae	15	3	1										19	44
Stygnocoris pedestris (Fall.)	0	0	0										0	
	3.8	.4	.2											
	0	0	0											
19. Pentatomidae								1					1	
Piezodorus lituratus (Fab.)								0					0	
20. Miridae	0						0	3			0	0	3	
Stenodema holsatum (Fab.)	3						1	0			3	2	9	
		1											1	
Stenodema calcaratum (Fall.)		0											0	
								1			0	12	13	
Monalocarnis filicis (Linn.)								0			1	0	1	
								5	26	57	49		137	
Trigonotylus ruficornis (Geoff.)								2	13	21	19		55	45
								1.0	4.3	9.5	7.0			
								.1	2.2	3.5	2.7			

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
Leptopterna ferrugata (Fall.)										35	39		74	46
										11	0		11	
										5.8	5.6			
Leptopterna dolabrata (Linn.)										1.8	0			
										0			0	
Capsus ater (Linn.)										2			2	
											0		0	
Pithanus maerkeli (H.-S.)											1		1	
									1	7			8	
Pachytomella parallela (M.-D.)									0	0			0	
	1		1						18	26	15		61	47
	0		0						0	21	0		21	
	.2		.2						3.0	4.3	2.1			
Plagiognathus arbustorum (Fab.)	0		0						0	3.5	0			
												0	0	
												2	2	
Lygus rugulipennis Popp.	1	1									2	1	5	
	0	0									3	0	3	
Calocoris norvegicus (Gmel.)										0	0		0	
										1	1		1	
Psallus sp.? varians (H.-S.)										0			0	
										1			1	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
IX NEUROPTERA														
1. Hemerobiidae	1												1	
Kimminsia nervosa (Fab.)	0												0	
X. LEIPDOPTERA														
1. Pieridae								2	1				3	
Pieris napi (Linn.)								0	0				0	
2. Eucosmidae									0				0	
Bactra lanceolata (Hiibn.)									1				1	
Laspeyresia ulicetana (Haw.)									2				2	
~~Crambus tristellus (Schiff.)~~									0	~~1~~			0 ~~1~~	
Argyroploce lacunana (Schiff.)									~~1~~ 1	~~1~~			~~1~~ 1	
Argyroploce sp.									0	1			0 1	
Enarmonia internana (Guense)									1	0			0 1	
									0				0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
3. Elachistidae														
Elachista rufocinerea (Howorth.)								2 0			1 0		3 0	
4. Tortricidae														
Cnephasia osseana (Scop.)											4 0		4 0	
5. Satyridae														
Coenonympha pamphilus (Linn.)									5 0	4 0			9 0	
6. Crambidae														
Crambus culmellus (Linn.)										13 0	16 0		29 0	48
Crambus tristellus (Schiff.)										2.5 0 1	2.3 0		1	
7. Caradrinidae										1			1	
Charaeas graminis (Linn.)											4 0	2 0	6 0	
Ceramica pisi (L.)												2 0	2 0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
8. Noctuidae	2												2	
Triphaena pronuba (Linn.)	0												0	
	2												2	
Apamea obscura (Gemina.)	0												0	
9. Arctiadae				1									1	
Phragmatobia fuliginosa (Linn.)				0									0	
10. Selidosemidae								1					1	
Ematurga atomaria (Linn.)								0					0	
11. Coleophoridae									1				1	
Coleophora sp.									1				1	
12. Plusiadae									1				1	
Euclidia mi (Clerck)									0				0	
13. Oecophoridae										1			1	
Endrosis sarcitrella (Linn.)										0			0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
14. Hydriominidae									5				5	
Ortholitha mucronata (Scop.)									0				0	
									2				2	
Xanthorhoe montanata (Schiff.)									0				0	
										0			0	
Hydriomena furcata (Thumb.)										1			1	
15. Tortricidae									2				2	
Tortrix viburniana Fabr.									0				0	
										3			3	
Cnephacia osseana (Scop.)										0			0	
16. Lasiocampidae												1	1	
Macrothylacia rubi (L)												0	0	
17. Agrotidae											1		1	
Diarsia festiva (Sch.)											0		0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
XI COLEOPTERA														
1. Staphylinidae	5	31		3	9	25	55	49	113	15	191	177	812	49
Amischa analis (Gr.)	0	7		2	2	15	11	18	21	75	79	67	286	
	1.3	3.9		1.0	3.0	3.6	11.0	9.8	18.8	25.7	27.3	29.5		
	0	.9		.7	.7	2.1	2.2	3.6	3.5	12.5	11.3	11.2		
								1	0	1			2	
Aleochara lanuginosa Gr.								1	2	0			3	
					11	0	3	3	1	3	7	0	28	50
Atheta atramentaria (Gyll.)					0	6	5	5	4	7	3	4	34	
					3.7	0	.6	.6	.2	.5	1.0	0		
					0	.8	1.0	1.0	.7	1.2	.4	.7		
					0								0	
Atheta longicornis (Gr.)					2								2	
								0	0	0			0	
Atheta atricolor Sharp								1	1	1			3	
								1			1		2	
Atheta crassicornis (F.)								0			1		1	
											0		0	
Atheta monticola Th.											1		1	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig No
				1			0	0	0		2	0	3	
Atheta gregaria (Fr.)				0			1	1	6		0	4	12	
	1			0				1				3	5	
Atheta fungi Gr.	0			1				9				0	10	
									0			0	0	
Autalia rivularis (Gr.)									1			1	2	
				1									1	
Astilbus canaliculatus (Fbr.)				0									0	
										0			0	
Bolitobius lunulatus (Linn.)										1			1	
								0					0	
Deliphrum tectum (Pk.)								1					1	
										0			0	
Gabrius splendidulus (Gr.)										1			1	
											1		1	
Hypocyptus longicornis (Paykull)											0		0	
								1					1	
Lesteva pubescens Man.								0					0	
								1		1			2	
Megarthus depressus (Paykull.)								0		0			0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
								1					1	
Mycetoporus brunneus (Marsh.)								0					0	
		0											0	
Omalium rivulare (Paykull.)		1											1	
	1	2	5			2	5		3	8	10	3	39	51
Othius melanocephalus (Gr.)	0	1	0			0	0		0	0	3	0	4	
	.2	.2	1.2			.3	10		.5	1.3	1.4	.5		
	0	.1	0			0	0		0	0	.4	0		
	1	3	4		1	1	2		0	2	14	5	33	52
Othius myrmecophilus (Kies.)	0	2	0		0	0	0		1	0	0	3	6	
	.2	.4	1.0		.3	.1	.4		0	.3	2.0	.8		
	0	.2	0		0	0	0		.2	0	0	.5		
		2		1	1							1	5	
Othius punctatus (Geo.)		0		0	0							0	0	
								0					0	
Oxyletus sculpturatus (Gr.)								1					1	
					1			0				1	2	
Oxytelus laqueatus (Marsh.)					0			1				0	1	
								1	0	0	0		1	
Oxytelus tetracarinatus (Block.)								0	1	1	1		3	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
		2			1			0					3	
Philonthus laminatus (Cr.)		0			0			1					1	
	1	1									1		3	
Philonthus fuscipennis (Man.)	2	1									0		3	
	1	2				1	1		0		4	4	13	
Philonthus varius (Gyll.)	0	0				0	0		2		1	0	3	
					1	1		0	0				2	
Philonthus varians (Pk.)					0	0		1	1				2	
		1				1						1	3	
Philonthus splendens (Fb.)		0				0						0	0	
									1				1	
Philorinum sordidum (Steph.)									0				0	
									0		0		0	
Platystethus arenarius (Gegl.)									2		1		3	
				1			1				1		3	
Quedius attemuatus (Gyll.)				0			0				0		0	
												1	1	
Quedius fuliginosus (Gr.)												0	0	
											2		2	
Quedius rufipes (Gr.)											0		0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
			1					3			2	3	9	
Quedius boops (Gr.)			0					0			0	0	0	
						1				1			2	
Quedius auricomus (Kies.)						0				0			0	
	0		0	2						3			5	
Stenus brunnipes Steph.	1		1	0						0			2	
					1		0	0					1	
Stenus nanus (Step.)					0		1	1					2	
		3	1									2	6	
Stenus impressus Germar.		0	0									0	0	
	0	0	1										1	
Stenus picipes Steph.	1	1	0										2	
					1					2	0		3	
Stenus clavicornis (Scop.)					0					0	1		1	
									0				0	
Stenus similis Hbst.									2				2	
										0			0	
Stenus loops Ljungh										1			1	
			1								2	1	4	
Staphylinus aeneocephalus De-G.			0								0	0	0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
					1	3			0	3	5	9	21	
Sipalia cercillaris (Gr.)					0	0			1	0	1	0	2	53
					0.3	.4			.0	.5	.7	1.5		
					0	0			.2	0	.1	0		
	1	3		2	3		2						11	
Tachinus rufipes (De.G.)	0	0		0	0		0						0	
					0								0	
Tachinus marginellus (F.)					1								1	
		0											0	
Tachinus collaris ler.		2											2	
							1				2		3	
Tachinus laticollis Gr.							0				0		0	
	1	1	0	2		1	1	0	3		2	2	13	54
Tachyporus pusillus (Gr.)	0	3	1	1		0	0	1	0		2	0	8	
	.2	.1		.7		.1	.2		.5		.3	.4		
	0	.4	.2	.3		0	0	.2	0		.3	0		
	1	1	2	7	13		3	3	0	1	3	1	35	55
Tachyporus chrysomelinus (Linn.)	0	0	0	0	0		0	5	7	2	2	0	16	
	.2	.1	.5	2.3	4.3		.6	.6		.2	.4	.2		
	0	0	0	0	0		0	1.0	.3	1.2	.3	0		
Tachyporus nitidulus (F.)												1	1	
												1	1	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
Tachyporus atriceps Steph.		0				1						2	3	
		1				0						0	1	
Tachyporus hypnorum (F.)					1		0		1			3	5	
					0		1		1			0	2	
Tinotus morion (Gr.)					1								1	
					0								0	
Xantholinus linearis (Ol.)	1	0	5	2		7		8		2	5	16	46	56
	0	4	0	0		15		0		1	0	0	20	
	.2		1.2	.7		1.0		1.6		.3	.7	2.7		
"Spp. indet."	0	.5	0	0		2.1		0		.2	0	0	39	
2. Helophoridae							0	0					0	
Helophorus minutus Fab.							1	1					2	
3. Scarabaeidae							1		0				1	
Aphodius ater (De.G.)							0		2				2	
								1					1	
Aphodius constans Duft.								0					0	
		0									2		2	
Aphodius rufipes (L.)		1									0		1	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
Aphodius ~~putridus Hbst.~~ *prodromus (Brahm)*			0										0	
			1										1	
Aphodius fossor (L.)									0				0	
									1				1	
Aphodius depressus (Kugel.)								0					0	
								1					1	
Aphodius contaminatus (Hbst.)	0										1	1	2	
	1										0	0	1	
4. Geotrupidae												1	1	
Geotrupes stercorarius (Linn.)												0	0	
5. Ptiliidae	0							0					0	
Acrotrichis anthracina Matth.	1							1					2	
								1					1	
Actinopteryx fucicola (All.)								0					0	
									1				1	
Baeocrara littoralis Th.									0				0	
			1			1							2	
Ptenidium pusillum (Gyll.)			0			0							0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
6. Chrysomilidae														
	2				11		20	6	1			16	56	
Lochmaea suturalis (Th.)	0				0		0	1	0			0	1	57
	.5				3.7		4.0	1.2	.2			2.7		
	0				0		0	.2	0			0		
	1		0										1	
Chrysolina marginata (Linn.)	1		1										2	
		0								0	0	0	0	
Longitarsus luridus (Scop.)		1								2	9	5	17	
*									0	0	1		1	
Crepidodera ferruginea (Scop.)									1	19	3		23	58
									0	0	.1			
									.2	3.2	.4			
7. Sphaeridiidae														
							1	1	5		1		8	
Cercyon melanocephalus (Linn.)							0	2	0		2		4	
												0	0	
Cercyon pygmaeus (Ill.)												1	1	
											0	0	0	
Cercyon terminatus (Marsh.)											1	1	2	
*Longitarsus succineus (Foud.)										1			1	
										0			0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
	1	0	0	0	1		1		0	1	0	0	4	59
Megasternum obscurum (Marsh.)	1	2	2	1	0		4		1	1	9	1	22	
	.2	0	0	0	.3		.2		0	.2	0	0		
	.2	.2	.5	.3	0		.8		.2	.2	1.3	.2		
		1											1	
Sphaeridium lunatum F.		0											0	
							1						1	
Sphaeridium scarabaeoides (L.)							0						0	
							1	2					3	
Cryptopleurum minutum (F.)							0	0					0	
8. Curculionidae														
	1										0		1	
Apion flavipes (Pk.)	0										1		1	
		0											0	
Barypithes sulcifrons (Boh.)		1											1	
			1										1	
Barynotus obscurus (Fab.)			0										0	
							0	1			1		2	
Ceuthorrhynchus contractus (Marsh.)							2	1			1		4	
								0	0			0	0	
Ceuthorrhynchus quadrimaculatus (Linn.)								4	2			2	8	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
Ceuthorrhynchus quadridens (Auz.)								0					0	
								1					1	
Micrelus ericae (Gyll.)					1				1				2	
					0				0				0	
Otiorrhynchus ovatus (Linn.)						0							0	
						1							1	
Otiorrhynchus singularis (Linn.)									2				2	
									0				0	
Otiorrhynchus ligneus (Ol.)						1			2				3	
						0			0				0	
Rhynchaenus (=Orchestes) fagi (L.)								2	1		9		12	
								1	1		2		4	
									0				0	
Phyllobius virideaeris (Laich.)									2				2	
									1				1	
Phyllobius pyri (Linn.)									0				0	
									0				0	
Phyllobius maculicornis Germ.									1				1	
			1				2						3	
Phytonomus plantaginis (De-G.)			0				0						0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for2 years	Fig. No.
							1				3	1	5	
Strophosomus lateralis (Pk.)							0				0	0	0	
							1			1			2	
Strophosomus melanogrammus (Forst.)							0			0			0	
	1			1								1	3	
Sitona tibialis (Hebst.)	0			0								0	0	
			0	0									0	
Sitona hispidulus (F.)			1	1									2	
		0			0								0	
Sitona flavescens (Marsh.)		1			1								2	
		0									0		0	
Sitona puncticollis Steph.		1									4		5	
9. Anisotomidae														
						1							1	
Catops chrysomeloides (Pz.)						0							0	
10. Cryptophagidae														
							1	2	1			1	5	
Micrambe vini (Pz.)							0	1	0			0	1	
		1											1	
Cryptophagus umbratus (Er.)		0											0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
11. Mycetophagidae		0					3		0				3	
Atomaria analis Er.		1					0		1				2	
								0			0		0	
Atomaria atricapilla Steph.								1			1		2	
12. Anisopodidae								0					0	
Ptomophagus subvillosus (Goeze)								2					2	
13. Coccinellidae	1						1	1	1	2	2	2	10	60
Coccinella septempunctata Linn.	0						0	0	1	5	1	1	8	
	.2						.2	.2	.2	.3	.3	.3		
	0						0	0	.2	4.8	.1	.2		
											1		1	
Coccinella hieroglyphica Linn.											0		0	
14. Elateridae		1				1							2	
Agriotes obscurus (Linn.)		0				0							0	
								1			1		2	
Agriotes sputator (Linn.)								0			0		0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
									1				1	
Athous haemorrhoidalis (F.)									0				0	
						1		1					2	
Corymbites tessellatus (F.)						0		0					0	
								3					3	
Corymbites pectinicornis (Linn.)								0					0	
							2	4				1	7	
Corymbites cupreus (F.)							0	0				0	0	
					1								1	
Cryptohypnus riparius (F.)					0								0	
							1						1	
Prosternon holosericeus (Ol.)							0						0	
									5				5	
Selatosomus incanus (Gyll.)									1				1	
									0				0	
Selatosomus incanus var. ochropterus (Steph.)									3				3	
15. Carabidae							0				1		1	
Amara plebeia (Gyll.)							1				0		1	
					1				1				2	
Bradycellus collaris (Pk.)					0				0				0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
									0			2	2	
Clivina fossor (Linn.)									1			0	1	
				1									1	
Crytonotus alpinus (F.)				0									0	
		2							1	2			5	
Calathus melanocaphalus (L.)		0							0	0			0	
									1				1	
Loricera pilicornis (F.)									0				0	
							1						1	
Pterostichus vulgaris (Linn.)							0						0	
				1									1	
Pterostichus strenuus (Pz.)				0									0	
											1		1	
Trechus rivularis (Gyll.)											0		0	
16. Lathridiidae		0						0					0	
Lathridius modifer West.		1						1					2	
	1								1				2	
Enicmus transversus (Ol.)	0								0				0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
Enicmus minutus (Linn.)											0		0	
											1		1	
17. Cateretidae														
								0	0	0	0	0	0	
Brachypterus glaber (Steph.)								3	31	29	9	1	70	61
								0	0	0	0	0	0	
								.6	5.2	4.8	1.3	.2		
									1				1	
Catereter rufilabris Lat.									0				0	
18. Nitidulidae														
								0					0	
Meligethes aeneus (F.)								1					1	
									1				1	
Meligethes rotundicollis Bris.									0				0	
												1	1	
Epuraea unicolor (Ol.)												0	0	
19. Byrrhidae											2		2	
Simplocaria semistriata (Fab.)											0		0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
20. Scydmaenidae											1		1	
Euconnus denticornis (Mull-Kunze)											0		0	
										1			1	
Euconnus claviger (Mull-Kunze)										0			0	
21. Cantharidae									13				13	62
Rhagonycha limbata Th.									8				8	
									2.2					
									1.3					
									0				0	
Cantharis nigricans (Mull.)									1				1	
									1				1	
Cantharis figurata Mann.									0				0	
									1				1	
Cantharis paludosa Fall.									0				0	
22. Parnidae									1				1	
Dryops ernesti Des.									0				0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
XII HYMENOPTERA														
1. Tenthredinidae							2	2					4	
Dolerus possilonsis Cameron							0	0					0	
							0	1					1	
Dolerus brevitarsus Hartig.							1	0					1	
							0						0	
Dolerus gonager (Fabricius)							1						1	
							1	0	1				2	
Dolerus picipes (Klug.)							0	1	1				2	
								1					1	
Dolerus aeneus Hartig								0					0	
								1					1	
Empria pumila (Konow)								0					0	
									1				1	
Empria liturata (Gmelin.)									0				0	
									1	0			1	
Nematus incompletus Forster									0	2			2	
								2					2	
Monophadnoides puncticeps (Konow)								1					1	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
								1	1				2	
Pachynematus clitellatus (Lepe.)								0	0				0	
							0	1	1	1	0	1	4	
Pachynematus apicalis (Hartig)							1	0	3	2	1	0	7	
									0				0	
Tenthredopsis nassata (Linn.)									2				2	
									1				1	
Tenthredopsis coquebertii (Klug.)									0				0	
2. Formicidae														
									0				0	
Formica fusca Linn.									1				1	
			1						2	4	3	35	45	63
Myrmica lobicornis Nyl.			0						0	0	1	0	1	
			.2						.3	.7	.4	5.8		
			0						0	0	.1	0		
								1			2	9	13	
Myrmica ruginodis Nyl.								0			0	0	0	

Species Collected		Total for 2 years
Braconidae	Spp. indet.	193
Ceraphrontidae		49
Cynipidae		67
Diapriidae		98
Diprionidae		11
Dryinidae		21
Embolemidae		11
Eurytomidae		12
Eubphidae		3
Figitidae		26
Ichneumonidae		209
Megalyridae		10
Mymaridae		59

Species Collected		Total for 2 years
Perilampidae		265
Pteromalidae		39
Proctotrupidae		27
Trichogrammatidae		3
Torymidae		16
Thysanidae		9

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
XIII DIPTERA														
1. Chironomidae		1	1								0		2	
Hydrobaenus aterrimus Meig.		1	0								2		3	
			1										1	
Hydrobaenus dispar Geet.			0										0	
		0											0	
Hydrobaenus pratorum Geet.		1											1	
			2			1							3	
Hydrobaenus foliaceus Kieff.			0			0							0	
						1							1	
Hydrobaenus sp.						0							0	
						1							1	
Metriocnemus hirticollis Stag.						0							0	
							0						0	
Metriocnemus hygropetricus Kieff.							1						1	
		2				1							3	
Metriocnemus fuscipes Meig.		0				0							0	
			2										2	
Metriocnemus platipus Edw.			0										0	
spp. indet.													14	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
		0											0	
Orthocladius sp. Edw.		3											3	
2. Lonchopteridae	3	4				0	0	0	0	0	1	13	21	
Lonchoptera furcata Fall.	14	9				2	13	37	49	39	83	39	285	64
	.8	.5				0	0	0	0	0	.1	2.2		
	3.5	1.1				.3	2.6	7.7	8.2	6.5	11.9	6.5		
				1		0	0	0				0	0	
Lonchoptera lutea Priz.				0		1	2	2				1	5	
3. Bibionidae							2						2	
Bibio varipes Hal.							0						0	
	0							0	169			0	169	65
Dilophus femoratus (Mg.)	2							16	0			5	23	
	0							0	23.2			0		
	.5							3.2	0			.8		
		1						53	56		0	9	119	66
Dilophus febrilis (Linn.)		0						65	0		139	49	253	
		.1						10.6	9.3		0	1.5		
		0						13.0	0		19.9	8.2		

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
	26	12										36	74	67
Bibio lepidus Loew.	3	0										4	7	
	6.5	1.5										6.0		
	.7	0										.7		
								3					3	
Bibio reticulatus Loew.								0					0	
4. Drosophilidae														
	0												0	
Parascaptomyza disticha (Duda.)	2												2	
	1								2			1	4	
Scaptomyza graminum (Fall.)	0								0			0	0	
							0	0					0	
Scaptomyza griseola Zett.							1	1					2	
5. Agromyzidae										0	0		0	
Domomyza nana (Meig.)										3	5		8	
										0	0	0	0	
Liriomyza orbona (Meig.)										9	3	4	16	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
	1	0					5	3		0	0	0	9	68
Phytomyza nigra Meig.	0	1					0	11		11	15	15	53	
	.2	0					1.0	.6		0	0	0		
	0	.1					0	2.2		1.8	2.1	2.5		
									0	5	11	29	45	69
Cerodonta denticornis (Panzer.)									18	65	55	49	187	
									0	.8	1.6	7.8		
									3.0	10.8	7.8	8.2		
6. Tipulidae														
								1					1	
Gnophomyia lugubris (Zett.)								0					0	
								1					1	
Limonia quadrinotata Meig.								0					0	
								113					113	70
Molophilus ater (Meig.)								0					0	
								22.6						
								0						
												1	1	
Molophilus niger Geot.												0	0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
								0					0	
Molophilus ozizeki Lack.								1					1	
								0					0	
Phalacrocera replicata (Linn.)								1					1	
									0				0	
Rhaphidolabis exclusa (Walker)									1				1	
								1					1	
Trichyphona immaculata (Meig.)								0					0	
								1					1	
Tipula macrocera Zett.								0					0	
								1			3	2	6	
Tipula paludosa Meig.								0			2	1	3	
											2	3	5	
Tipula melanocerus Schummel											2	0	2	
												1	1	
Tipula subnodicornis Zett.												0	0	
								2					2	
Taphrophila vitripennis (Meig.)								0					0	
											0		0	
Limonia maculipennis Meig.											2		2	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
7. Psychodidae								1					1	
Clytocerus ocellaris (Meig.)								0					0	
											0		0	
Psychoda albipennis Zett.											3		3	
								3					3	
Psychoda crassipennis Tonn.								0					0	
							2	1			4	3	10	
Psychoda phalaenoides (Linn.)							0	0			0	0	0	
										5	9	8	22	
Psychoda setigera Tonnoir										0	3	4	7	71
										.8	1.3	1.3		
										0	.7	.7		
												0	0	
Psychoda spreta Tonn.												1	1	
8. Mycetophilidae		0				1						1	2	
Allodia crassicornis (Stan.)		1				0						0	1	
											1		1	
Boletina villosa Land.											0		0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
	38						5	9			45	13	110	
Sciara quinquelineta Mg.	15						9	11			94	23	152	72
	9.5						1.0	1.8			6.4	2.2		
	3.8						1.8	2.2			13.4	3.8		
							9	1		0	34	12	56	
Sciara autumnalis Winn.							2	8		65	49	27	151	73
							1.8	.2		0	4.8	2.0		
							.4	1.6		10.8	7.0	4.5		
											0		0	
Leia fascipennis Mg.											1		1	
"Spp. indet."													5	
9. Phoridae												0	0	
Aphiochaeta vernalis Wood												1	1	
									4	0	15	3	22	74
Beckerina umbimargo (Beck.)									0	6	19	0	25	
									.7	0	2.1	.5		
									0	1.0	2.7	0		
							1						1	
Chaetoneura urbana(Mg.)							0						0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig No
												0	0	
Phora abdominalis Fln.												1	1	
											2		2	
Dohrniphora crassicornis Meig.											0		0	
						1	0	9		0	4	0	14	75
Parastenophora gracilis Wood.						0	3	0		11	0	7	20	
						.1	0	1.8		0	.6	0		
						0	.6	0		1.8	0	1.2		
						0							0	
Trupheomura opaca Meig.						1							1	
10. Ephydridae														
						2	0		0				2	
Hyadina guttata (Fall.)						0	4		2				6	
	0	0							9	11	5	19	44	76
Hydrellia griseola (Fall.)	97	16							95	190	270	241	909	
	0	0							1.5	1.8	.7	3.2		
	24.2	2.0							15.8	31.7	38.6	40.1		
						1							1	
Scatella stagnalis Fall.						1							1	
		1	1										2	
Napaea quadripunctata Meig.		0	0										0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig No.
11. Sphaeroceridae						3	0	5	17	9	10	3	47	
Borborus hirtipes (R-D)						0	5	13	29	69	37	11	164	77
						.4	0	1.0	2.8	1.5	1.4	.5		
						0	1.0	2.6	4.8	11.5	5.3	1.8		
	0				1	0							1	
Limosina crassimana Hal.	1				0	1							2	
						1	2	5	3	9	0	0	20	
Limosina rufilabris Stenh.						1	7	11	9	16	18	11	73	78
						.1	.4	1.0	.5	1.5	0	0		
						.1	1.4	2.4	1.5	2.7	2.6	1.8		
						1							1	
Paracollinella fontinalis (Fall.)						1							1	
							0	0					0	
Sphaerocera curvipes Latr.							1	2					3	
						1							1	
Sphaerocera nitida Duda.						0							0	
12. Opomyzidae														
		0						0			0		0	
Geomyza tripunctata Fall.		3						1			4		8	
	0								0	19	27	23	69	
Opomyza germinationis (Linn.)	41								39	45	79	67	271	79
	0								0	3.2	3.9	3.8		
	10.2								6.5	7.5	11.3	11.2		

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
13. Sepsidae						3	5	0		0	31	0	39	80
Sepsis punctum (Fab.)						0	1	19		21	11	4	56	
						.4	1.0	0		0	4.4	0		
						0	.2	3.8		3.5	1.6	.7		
							1	9	7	6	0		22	81
Sepsis fulgens Mg.							0	21	27	29	14		91	
							.2	1.8	1.2	1.0	0			
							0	4.2	4.8	4.8	2.0			
14. Psilidae								1	0	1			2	
Psila nigra (Fln.)								0	5	5			10	
15. Diastatidae			0					0					0	
Diastata vagans Loew.			1					1					2	
16. Chloropidae										0	0		0	
Chlorops elongata Meig.										13	3		16	
											0		0	
Chloropis ca glabra (Meig.)											1		1	
										1			1	
Chlorops interrupta Meig.										0			0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
									0		2		2	
Chlorops pumilionis (Bjerk.)									16		2		18	
									0	3	7	2	12	
Chlorops puncticollis (Zett.)									1	0	0	0	1	
	0								3	5	3	1	12	
Meromyza pratorum Meig.	1								0	0	2	0	3	
								25	45	19	21		110	
Oscinella nigerrima Meg.								9	11	31	69		120	82
								5.0	7.5	3.2	3.0			
								1.8	1.8	5.2	9.9			
								1	11	0	0		12	83
Oscinella albiseta (Mg.)								0	29	15	5		49	
								.2	1.8	0	0			
								0	4.8	2.5	.7			
				1				11	37	41	87	13	190	
Oscinella frit (Linn.)				0				5	113	29	127	95	409	84
17. Cecidomyiidae							0	3			5		8	85
Campylomyza pumila Winn.							2	4			9		15	
							0	.6			.7			
							.4	.8			1.3			

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
							1						1	
Catocha latipes Hal.							0						0	
							3						3	
Campylomyza bicolor (Meig.)							0						0	
											0		0	
Joannisia fungicola Kieff.											1		1	
						0	1	3	4	7	2	1	18	
Joannisia nodosa Edw.						.2	.3	9	13	11	21	13	72	86
						0	.2	.6	.7	1.2	.3	.2		
						.3	.6	1.8	2.2	1.8	3.0	2.1		
							0					1	1	
Lestremia cinerea (Edw.)							1					0	1	
											1	0	1	
Lestremia defecta Winn.											0	1	1	
"Spp. indet."													2	
18. Anisopodidae								0					0	
Anisopus punctatus (Fab.)								1					1	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
19. Muscidae														
								0		0			0	
Agria sp.								1		1			2	
										2	2	0	4	
Coenosia pumila (Fall.)										0	0	4	4	
											0		0	
Coenosia sexnotata Meig.											1		1	
											1		1	
Dasyphora cyanella (Meig.)											0		0	
												0	0	
Delia quadripila (Stein.)												1	1	
											0		0	
Drymeia hamata (Fall.)											1		1	
										0			0	
Egle cinerella (Fall.)										4			4	
										0			0	
Egle parva (Rob Desv.)										2			2	
												1	1	
Fannia canicularis (Linn.)												0	0	
											0		0	
Haematobia simulans (Meig.)											1		1	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
	0											0	0	
Hebecnema umbratica (Meig.)	2											2	4	
								2	0	2			4	
Helina annosa								0	1	2			3	
								1					1	
Helina duplicata (Meig.)								0					0	
											0		0	
Helina fratercula (Zett.)											1		1	
	1												1	
Helina impuncta (Fall.)	0												0	
								1				1	2	
Helina lucorum (Fall.)								0				1	1	
												0	0	
Helina tinctipennis Stein.												1	1	
								0					0	
Hydrophoria ruralis (Meig.)								1					1	
											1		1	
Hydrotaea armipes (Fall.)											0		0	
											1		1	
Hydrotaea irritans (Fall.)											0		0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
								0					0	
Hylemyia strenua R-D.								1					1	
	5	1					3	26	14	6	5	11	71	87
Hylemyia variata (Fall.)	1	0					7	31	5	13	2	2	61	
	1.2	.1					.6	5.2	2.3	1.0	.7	1.8		
	.2	0					1.4	6.2	.8	2.2	.3	.3		
	1									0			1	
Limnophora contractifrons (Zett.)	0									1			1	
												1	1	
Mesembrina meridiana (Linn.)												0	0	
									1				1	
Morelia hortorum (Fall.)									0				0	
									0		0		0	
Nupedia dissecta (Meig.)									2		4		6	
												2	2	
Orthellia caesarion (Meig.)												0	0	
	1												1	
Pegomyia minima Stein.	0												0	
								3	0				3	
Pegohylemyia humerella (Zett.)								0	12				12	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig No.
											0		0	
Pegohylemyia lamelliseta (Stein.)											2		2	
											1		1	
Phorbia unipila (Karl)											0		0	
												1	1	
Pseudophaonia hirticrura (Meade)												0	0	
"Spp. indet."													5	
20. Cordiluridae								5					5	
Amaurosoma tibiella (Zett.)								4					4	
								0					0	
Norellisoma spinimanum (Fall.)								1					1	
	0	1					1	8	12	0	1	1	24	88
Scopeuma stercorarium (Linn.)	2	0					1	12	7	9	11	2	44	
	0	.1					.2	1.6	2.0	0	.1	.2		
	.5	0					.2	2.4	1.2	1.5	1.6	.3		
									1				1	
Scopeuma suillum (Fab.)									0				0	
21. Syrphidae								1					1	
Chilosia variabilis Pz.								0					0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
Melanostoma mellinum (Linn.)											0		0	
M. mellinum dubium (Zett.)											1		1	
Platychirus albimanus (Fab.)											0		0	
Platychirus discimanus Loew.									4	6	1		11	
Platychirus podagratus (Zett.)									0	0	0		0	
Platychirus sticticus (Meig.)									8				8	
Paragus tibialis (Fall.)									0				0	
Sphaerophoria menthastri (Linn.)									4	1			7	
Sphaerophoria menthastri var picta (Meig.)									0	0	0		0	
Syrphus ribesii (Linn.)									0		1		1	
									0		0		0	
									1				1	
									0				0	
									1				1	
									0				0	
										3			3	
										1			1	
											0		0	
											1		1	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
22. Empididae									26				26	89
Bicellaria pilosa Lund.									0 4.3				0	
Bicellaria spuria (Fall.)									0 7	3	0		10	90
									0 1.2	6 .5	9 0		15	
Clinocera nigra Meig.									0	1.0	1.3 1		1	
Clinocera zetterstedti (Fall.)										0	0 0		0 0	
Dolichocephala irrorata (Fall.)									1 0	1	1		2 1 0	
Hilara maura (Fab.)										0	1 0		1 0	
Hybos culiciformis (Fabr.)											1		1	
~~Hybos femoratus (Muell.)~~									~~1~~ ~~0~~				~~1~~ ~~0~~	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
Hybos femoratus (Muell.)									1				1	
									0				0	
											0		0	
Platypalpus albiseta Panz.											1		1	
								5		0	5		10	
Platypalpus nigritarsis (Fall.)								0		22	3		25	91
								1.0		o	.7			
								0		3.7	.4			
										0	0	0	0	
Platypalpus cursitans (Fabr.)										4	14	1	19	92
										0	0	0		
										.7	2.0	.2		
								0			0		0	
Platypalpus fulvipes Meig.								3			8		11	
									0				0	
Platypalpus fuscicornis Zett.									9				9	
								8					8	
Platypalpus longicornis (Meig.)								0					0	
											0	1	1	
Platypalpus longitarsus Meig.											1	1	2	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
								1					1	
Rhamphomyia plumipes (Meig.)								0					0	
								0					0	
Rhamphomyia obscura (Zett.)								2					2	
											10		10	
Rhamphomyia tarsata (Meig.)											0		0	
								0					0	
Rhamphomyia spinipes (Fall.)								2					2	
											1		1	
Tachista arrogans Linn.											0		0	
											1	0	1	
Tachypeza fuscipennis (Fall.)											0	1	1	
												0	0	
Tachypeza nubila (Meig.)												1	1	
"Spp. indet."													2	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
23. Stratiomyidae									0				0	
Beris vallata(Forst.)									1				1	
									0				0	
Michrochrysa flavicornis(Mg.)									1				1	
										0			0	
Sargus rufipes(Wahlberg.)										1			1	
24. Rhagionidae										0			0	
Leptis tringaria(Linn.)										1			1	
									1				1	
Leptis scolopacea(Linn.)									0				0	
25. Ceratopogonidae									1				1	
Culicoides punctatus(Linn.)									0				0	
								1	4				5	
Serromyia femorata(Meig.)								0	0				0	
26. Helomyzidae							2						2	
Helomyza flavifrons(Zett.)							0						0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
									1				1	
Helomyza funcicornis (Zett.)									0				0	
									1	1			2	
Heteromyza commixata Coll.									0	6			6	
27. Chamaemyiidae										1	7		8	
Chamaemyia aridella (Fall.)										0	0		0	
									5	23	4		32	93
Chamaemyia geniculata (Zett.)									9	0	0		9	
									.8	3.8	.6			
									1.5	0	0			
								0	4	26	5		35	94
Chamaemyia juncorum (Fall.)								2	23	0	0		25	
								0	.7	4.3	.7			
								.4	3.8	0	0			
28. Scatopsidae								1	27	0	2		30	95
Psectrosciara coxendrix (Verr.)								0	0	7	2		9	
								.2	4.5	0	.3			
								0	0	1.2	.3			

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
	1												1	
Scatopse fuscipes Mg.	0												0	
29. Ptychopteridae								1					1	
Ptychoptera minuta (Tonnoir)								0					0	
30. Simuliidae	0							0					0	
Simulium ornatum Mg.	1							1					2	
								1			1		2	
Simulium tuberosum Lund.								0			0		0	
31. Calliphoridae												0	0	
Calliphora erythrocephala (Meig.)												1	1	
32. Dolichopodidae											1		1	
Aphrosylus ferox Walk.											0		0	
									0		0		0	
Dolichopus arbustorum staun.									5		1		6	
											1		1	
Dolichopus phaeopus Hal Walker											0		0	

Species Collected	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sep.	Total for 2 years	Fig. No.
Dolichopus vitripennis Meig.										2			2	
										0			0	
										0	0		0	
Ectomus alpinus(Hal.)										1	1		2	
								0					0	
Hydrophorus bisetus Lw.								1					1	
	0												0	
Micromorphus albipes(Zett.)	1												1	
											0		0	
Sympycnus annulipes(Meig.)											3		3	
33. Trichoceridae		2											2	
Trichocera parva Meig.		3											3	
	1	6	1										8	
Trichocera saltator(Harris.)	1	1	1										3	
												2	2	
Trichocera regelationis(Linn.)												0	0	
34. Dorilaidae										1	1		2	
Dorilas sylvaticus(Mg.)										1	1		2	

DISCUSSION

(i) Distribution of total catches throughout the year.

As would be expected the number of insects obtained by sweeping was greatest in the summer months decreasing gradually in autumn to a very low winter level and increasing again in spring. This is shown in figure 96.

In the case of insects collected from the soil, their distribution throughout the year tended in the reverse direction, in that the numbers were greatest in winter and least in mid summer (see figure 97). The winter increase is probably due in some small part to insects which live above ground in summer spending the winter below ground, but this can only be a relatively small part of the explanation as no species found in large numbers above ground in summer appeared in large numbers below ground in winter samples. The major explanation must be in the very marked increase of the herbage insects in summer and their marked decrease in autumn. The numbers of soil insects remained more constant throughout the year but the results indicate that their numbers do increase during the autumn and early winter months, other than by migration from above ground.

It has been shown by Cameron (1917, 1924), Payne (1927) and 1928), Morris (1920) and Mail (1930 and 1932) that insects which pass the winter in soil are, in general, able to resist frost when in the surface layers of the soil and it is not necessary for them to burrow deeply. While my samples were not divided into horizontal sub-samples, observation of such insects /

insects which could be made in taking and handling the soil samples tended to confirm these findings for pastures at an elevation averaging 900 feet and subject to more severe winter climatic conditions than those pertaining in areas where these workers made their investigations. While in certain samplings in winter no insects were obtained from the herbage, certain soil-dwelling species, particularly the Collembola, Onychiurus, armatus (Tull.) Friesia mirabilis (Tull.) Hypogastrura armata (Nic.), Folsomia quadrioculata (Tull.) and Isotoma violacea Tull, the thrips Aptinothrips rufus (Gme.) and the Coccid Ripersia halophila (Hardy) were most common in winter.

(ii) The number of species collected

The number of species collected over the two years of the investigation was 518. These belonged to 114 families in 13 orders. This number is greater than the numbers represented in the collections of the workers referred to previously, except in the case of Osborn (1939), as is shown in table II. In the case of Osborn's book the number given in the total of species recorded in his own investigations and those of other workers quoted by him. I do not think that this greater number necessarily indicates a richer fauna in the area of my investigation. In previous investigations the time involved was often less and the samples sometimes smaller, particularly in the case of some investigations involving soil fauna only. Moreover, most of the previous workers referred to, investigated only the soil or the herbage insects while the total in this work includes both. The method used here for separating insects from /

Table II.

Kind of Survey	Name and Year of Investigator	No. of Orders recorded	No. of Families recorded	No. of Species recorded.
A. Soil Fauna	McAtee (1907)	5	-	29
	Cameron (1913)	8	-	167
	Buckle (1921)	6	-	72
	Morris (1922)	9	27	83
	Thompson (1924)	7	33	81
	Edwards (1929)	7	-	96
	Ford (1935)	9	34	73
	Wolcott (1937)	9	45	258
	Strickland (1947)	9	32	58
	Salt, Hollick et al.(1948)	7	33	77
B. Herbage Fauna	Miles (1921)	7	-	17
	Lever (1937)	7	-	100
	Osborn (1939)	7	-	655
	Cumber & Harrison and Cumber(1958,1959 a,b,c,d,e &f)	9	87	276
C. Soil and Herbage Fauna	Morris (1920)	7	60	175
	Cumber (1960b)	6	29	59
	Present work	13	114	518

from the soil samples is more efficient than the methods used by certain other workers some of whom contented themselves with the study of those insects which could be picked from the soil by hand.

(iii) Species occurring in the different types of pasture

Buckle (1921 and 1923) found that the change in the insect fauna brought about by the conversion of pasture to arable land was very slight, at least as far as the general soil fauna was concerned. In other words there was no "arable fauna" as distinct from a "permanent-pasture fauna". The present results extend these, by indicating that there is no marked difference between the fauna of the fields which had been ploughed from hill land and that of the unaltered hill. Those differences which were found could be explained by particular differences in the environments of the various areas.

The CPL/BH environment differed from the other three in that the vegetation was "improved", from the agricultural point of view by the ploughing and re-seeding which had taken place. The sward was of a more uniform consistency both in height and in the species of plants present, being dominated by useful agricultural grasses particularly ryegrasses and cock'sfoot. In the area CPL/BH, therefore, it is not surprising that the least number of species was recorded, viz. 102 species compared with an average of 139 species from the other three plots. The CPL/HG plot differed from CPL/BH in that, not having been ploughed for many years, it was much rougher and more weedy and produced certain insects /

insects associated with particular weeds. A further difference of a more temporary nature was that during the years of the investigation CPL/HG was grazed by cattle and sheep while CPL/BH was grazed by sheep only. Certain insects more particularly associated with cow-dung pats were thus found on this area more commonly than on CPL/BH. Due to the natural scatter of insects, however, these species were by no means confined to CPL/HG. Certain of the Empididae, Muscidae, Cordiluridae and Sepsidae are examples of such insects. On the PPL plots, Elateridae, Staphylinidae, Capsidae and Jassidae were found to be more abundant both in the number of species found and in the number of individuals within the species.

(iv) Discussion order by order

In what follows only those orders, families or species, which have proved of special interest, due to their abudnance or for other reasons, are mentioned. Other data are contained in the tables and figures.

Collembola

The Collembola can be divided into two distinct groups; one of these became very abundant in summer time and disappeared altogether from the samples taken in winter. Such belonged to the families Entomobryidae and Sminthuridae and the species Isotoma viridis Bour. of the Isotomidae. The other group occurred all the year round but were much more abundant in the winter samples. These occurred in the families Hypogastruridae, Achorutidae and Onychiuridae and the species Folsomia quadrioculata (Tull.) and Isotoma violacea /

violacea Tull. All the species of the Isotomidae of the winter-abundant group were collected from the turf samples; but of the summer-abundant group the Entomobryidae and Sminthurinus niger (Lubb.) occurred in the turf samples while Sminthurus viridis (Linn.) and Isotoma viridis were collected both from the turf and the herbage. All the species occurred in all plots except those in the Entomobryidae which were confined to the PPL plots.

Orthoptera

Only one species was collected Omocestus viridulus (Linn.), Acrididae, represented by only eleven specimens but all from the PPL.

Thysanoptera

The only thrips of interest was Aptinothrips rufus (Gme.) which was collected throughout the year, became more abundant in winter and was obtained mainly from the turf samples.

Hemiptera

In the Cercopidae three species were collected of which Neophilaenus exclamationis (Th.) came entirely, and the other two species, almost entirely from the PPL. In the Coccidae Ripersia halophila (Hardy) occurred in the soil all the year round, was much more common in CPL and more abundant in the winter samples. In the Triozidae Trioza albiventris (Frost.) was collected much more abundantly from CPL/BH in the first year of the investigation when some thistles had not been cut on this plot. As already mentioned the Jassidae were more abundant on PPL except Macrosteles laevis Rib. /

laevis Rib., found in considerable numbers on CPL/HG but absent from CPL/BH, from which taller grasses, on which M. laevis is normally found, were absent. Hardya melanopsis (Hardy.) was collected in every month of the year, but not in every collection, being lowest in spring and highest in autumn. All the other Jassids collected were greatest in number in summer and autumn but were not obtained in winter. In my determination of Aphid species, I re-sorted the collection placing all individuals of each species in one tube irrespective of the place and date of collection. My earlier determinations, made with the help of Theobald (1926 - 29) proved, as a result of greater experience, to be mistaken in some cases. This re-sorting then proved to have been very unfortunate as I was unable to ascertain which individuals, as originally determined, belonged to which collection. I am able therefore, to record only the species of aphids collected and the total number of individuals of each species during the time of investigation. The collection of 42 specimens of Drepanosiphum platanoides (Sch.) on the pasture can only be explained by their having come from sycamore trees in the vicinity.

Coleoptera

As mentioned previously the Staphylinidae were more abundant on PPL and the occurrence of the most abundant species, Amischa analis (Gr.), was unusual in that its numbers increased gradually from early spring until September when they suddenly dropped to practically zero. No explanation can be offered of this distribution in time. Of the /

the Coleopterous species collected the Staphylinidae constituted almost half. The determination of the species of the genus Quedius proved difficult and the names given should be considered provisional. The Chrysomelid Lochmaea suturalis (Th.) was recorded only from PPL/HG, which was the only area carrying its food plant. The Curculionidae were represented by many species but only very few individuals of each, the most abundant being Rhynchaenus fagi (Linn.) which had come from beech trees surrounding CPL/HG.

Diptera

The only two Lonchopteridae collected numbered over 300 specimens of which 93 per cent came from CPL. Among Bibionidae Dilophus femoratus (Mg.) Dilophus febrilis (L.) and Bihio lepidus Lw. appeared in fair numbers. D. femoratus and B. lepidus had one generation per year, the peak numbers of adults appearing in May-June and September-October respectively. A very few individuals of D. femoratus appeared in September-October indicating a small partial second generation. D. febrilis showed two approximately equal adult peaks in May-June and August-September. Among the Empididae no less than 22 species were recorded all in small numbers but I found difficulty with their determinations of which I must regard some as provisional.

Among the Chloropidae the bulk of the specimens came in the genus Oscinella particularly O. frit (Linn.), which indicates that there is a reservoir of this pest in upland pasture.

Among the Ephydridae Hydrellia griseola (Fall.) was very numerous from May to October with one peak of abundance in /

in September. It was almost confined to the CPL plots.

(v) Distribution in the orders

Of all the species collected the Diptera constituted 37.3 per cent, the Coleoptera 28.5 per cent, the Hemiptera 18.5 per cent and the other ten orders collected, taken together, 15.7 per cent. The details are set out in Table III.

Table III.

Orders.	No. of Families in each Order.	No. of Species in each Order.
1 Diplura	1	1
2 Collembola	7	16
3 Plecoptera	2	3
4 Orthoptera	1	1
5 Dermaptera	1	1
6 Psocoptera	5	6
7 Thysanoptera	1	9
8 Hemiptera	20	96
9 Neuroptera	1	1
10 Lepidoptera	17	27
11 Coleoptera	22	148
12 Hymenoptera	2	16
13 Diptera	34	193
Total	114	518

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nature in this thesis despite the fact that he has not yet published on it.

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~~III. Diptera~~	~~741 - 62.~~
IV. Coleoptera	763 - 72.
V. Hymenoptera	874 - 97.
VI. Psocoptera	898 - 902.
VII. Thysanoptera	1123 - 30.
VIII. Orthoptera	1132 - 36.

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SUMMARY

Despite the agricultural importance of grasslands and the very large area of upland pasture in Scotland, little attempt has been made to study the insects of this habitat. This is largely due to the fact that in the more natural environment of grassland, insects but seldom increase in numbers to such an extent as to be serious pests.

The thesis reviews briefly allied work on insects of pasture, with regard to methods and results. The pastures examined in this work form part of the upland ground of two farms of The Edinburgh School of Agriculture, and consisted of two fields at about 900 feet elevation, and a portion of unfenced hill land neighbouring each field. One field had been last ploughed in 1956, and the other about 1935; the hill land not within living memory. Periodic collections of insects were made from October 1958 to September 1960, from these four areas by taking samples (a) of turf, from which the insects were removed in the laboratory by the Tullgren-funnel method, and (b) samples from the herbage by the use of a sweep net. The insects from these various samples were separated into their orders, families, and in practically all cases, species.

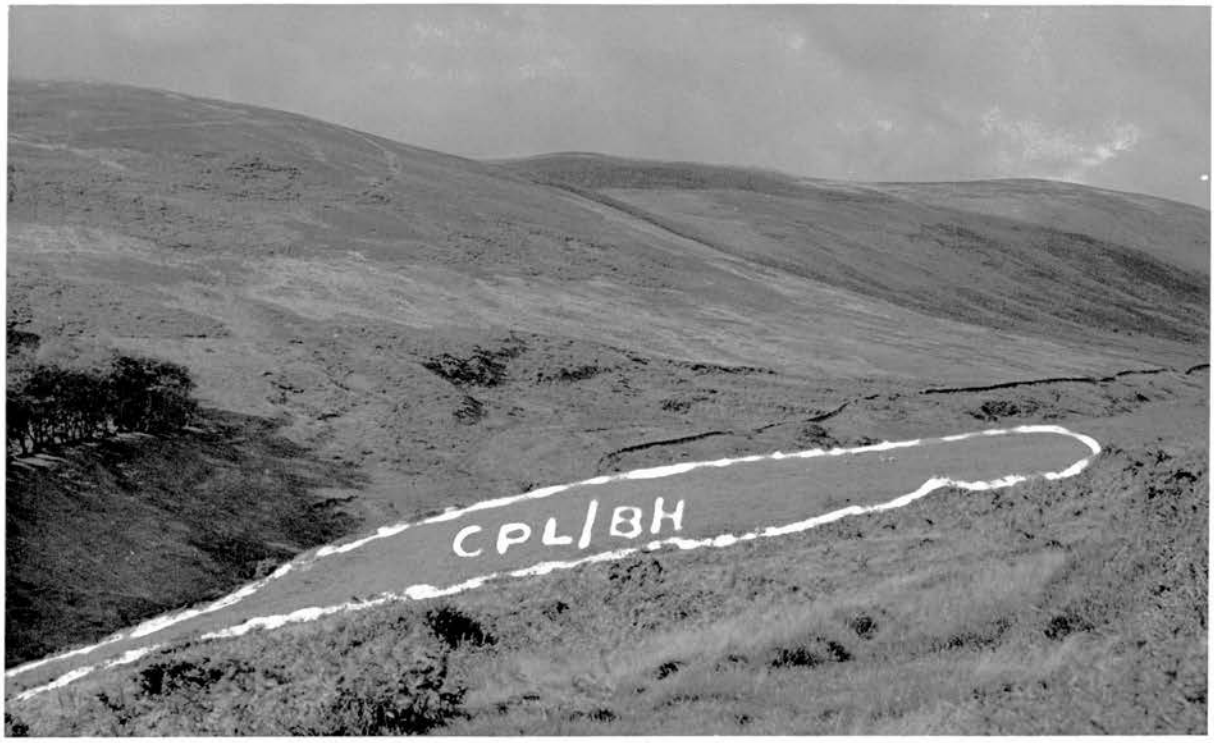
The results of the study showed that the insect faunas of the hill pastures did not differ appreciably from those of the fields which had been ploughed and subsequently resown. Most of such differences as did occur could be explained by factors in the habitat such as the occurrence of the food plant of a

particular insect species on one or more of the plots, or pasturage by cattle as well as by sheep.

Records were kept of the relative abundance of the various species in the samples throughout the two years of the investigation. These have been shown as monthly totals and averages in tabular form and in the form of histograms in the case of those species which were found in sufficient numbers to justify this procedure.

Five-hundred and eighteen species were recorded in all, these being distributed in 114 families of 13 orders. Of the species collected, 37.3 per cent belonged to the Diptera, 28.5 per cent to the Coleoptera, 18.5 per cent to the Hemiptera and the remaining 15.7 per cent to ten other orders. Although it was hoped at the beginning of this work that some appreciable differences might have been found in the insect ecology of the two types of upland pasture, only small differences have been shown to exist. Nevertheless, much information has been gathered and a detailed list given of the insect faunas of these hill areas, a task which has not previously been attempted in Scotland or, as far as is known, in Britain.

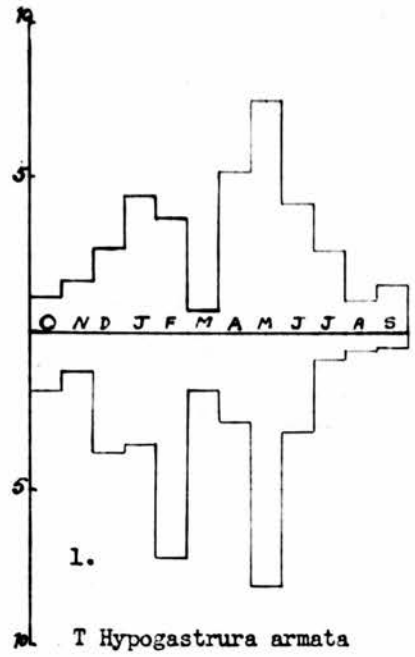
A



Leips Field, Boghall Farm.

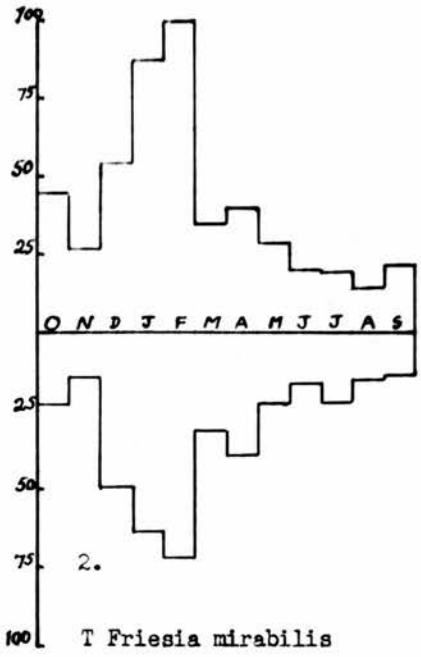
B

Upper Fulford Field, Easter Howgate Farm.



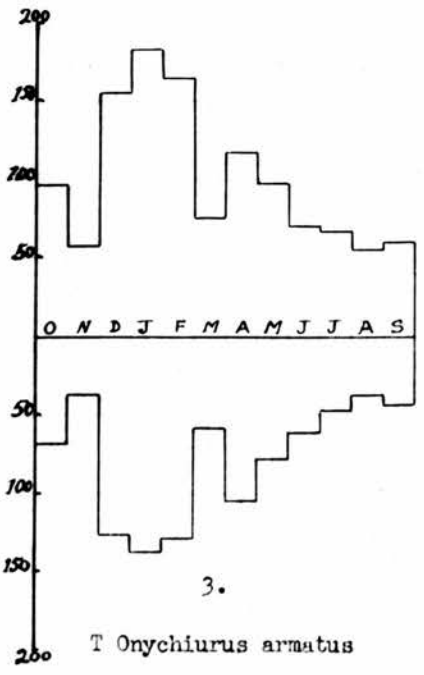
1.

T Hypogastrura armata



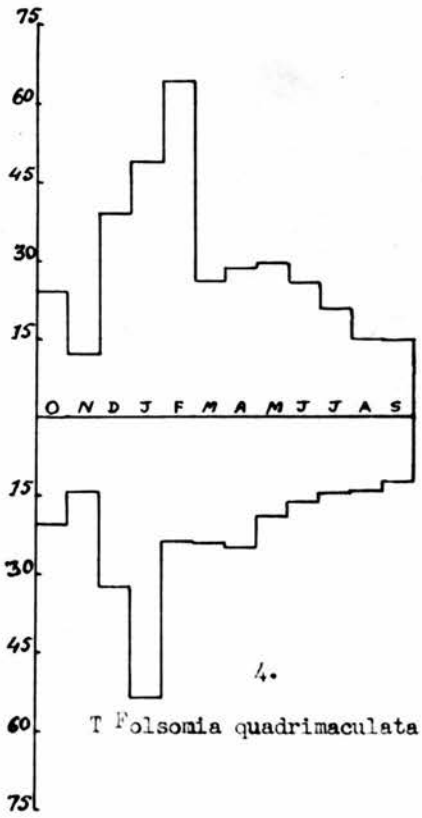
2.

T Friesia mirabilis



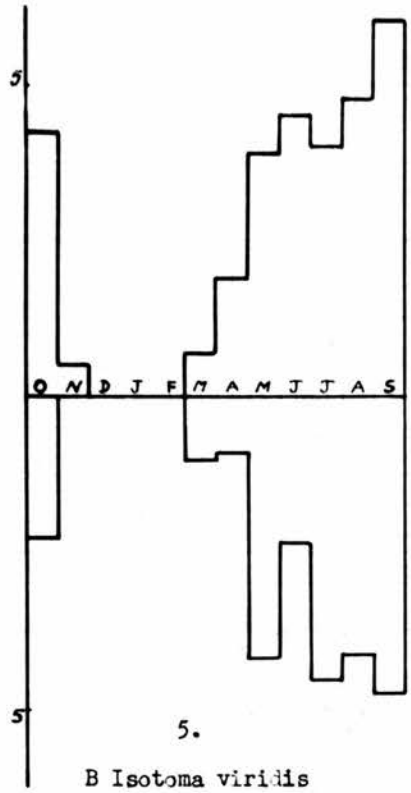
3.

T Onychiurus armatus



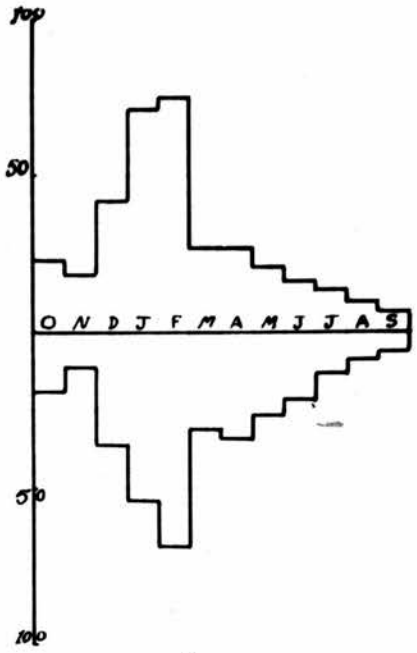
4.

T Folsomia quadrimaculata



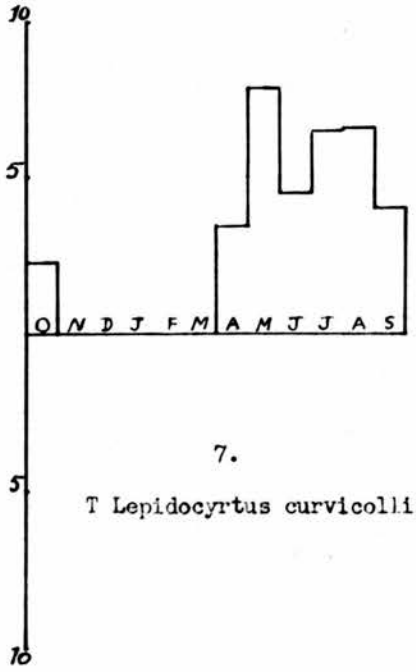
5.

B Isotoma viridis



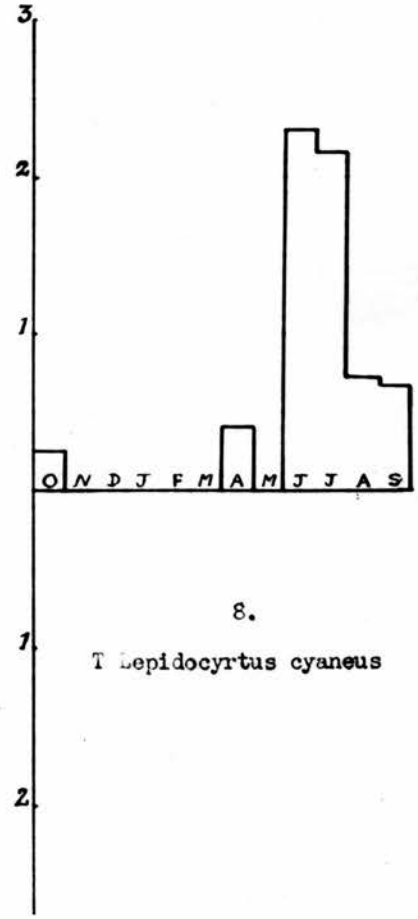
6.

T Isotoma violacea



7.

T Lepidocyrtus curvicollis



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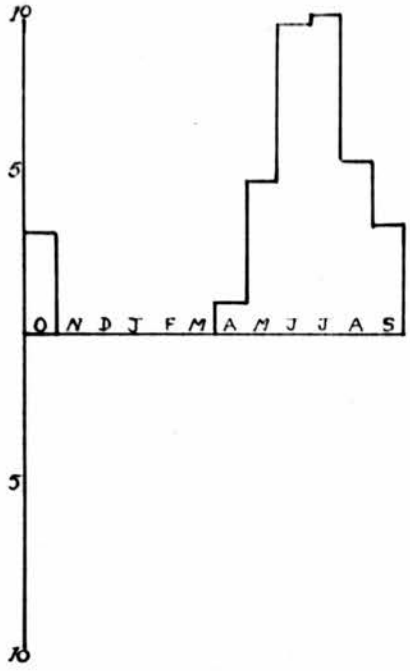
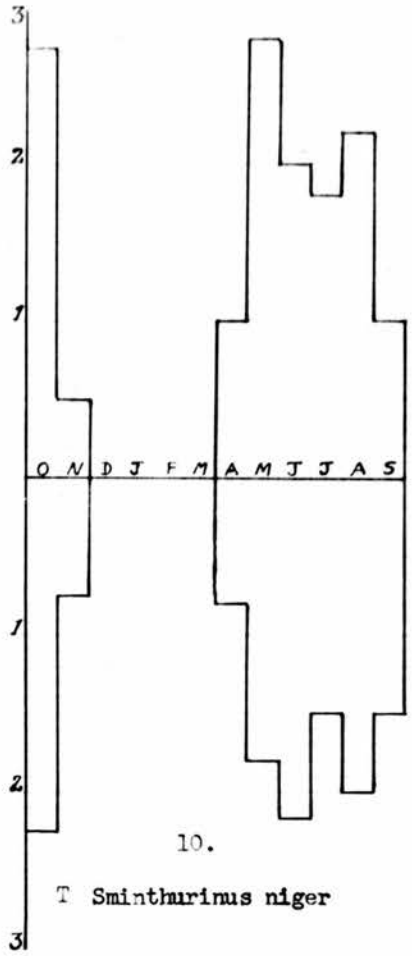
T Lepidocyrtus cyaneus



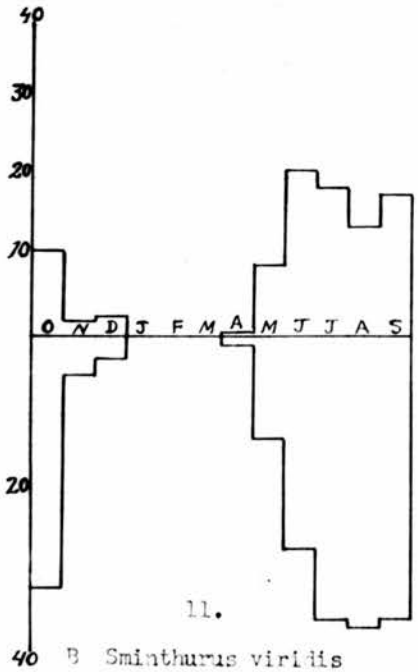
9.

T Entomobrya nivalis



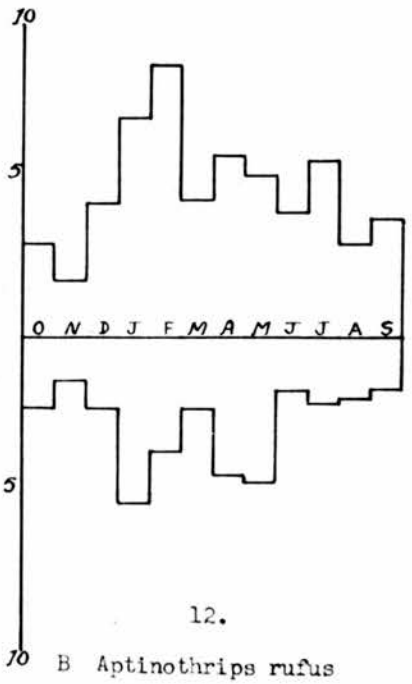
10.

T Sminthurinus niger



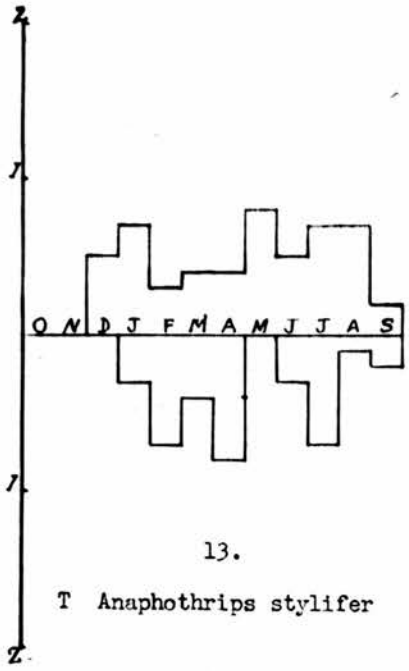
11.

B Sminthurus viridis



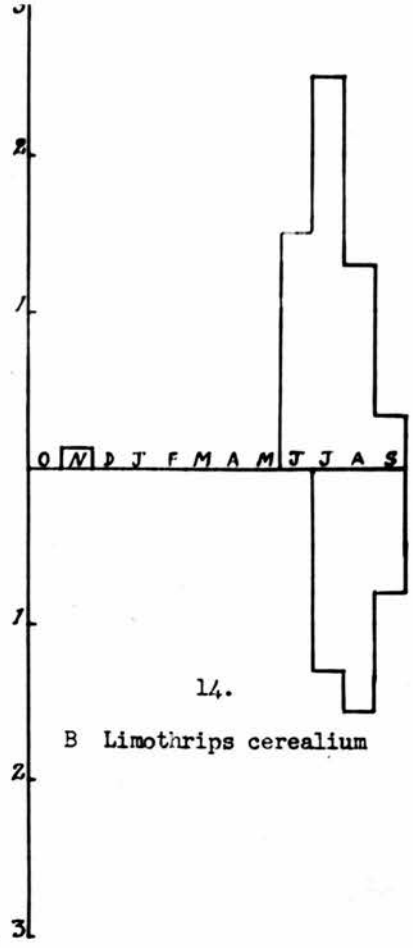
12.

B Aptinothrips rufus



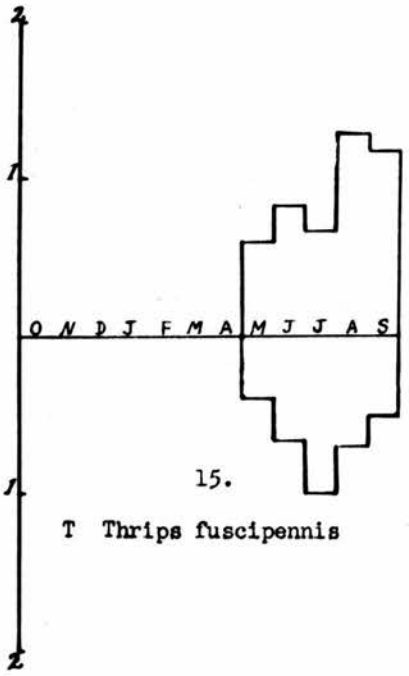
13.

T Anaphothrips stylifer



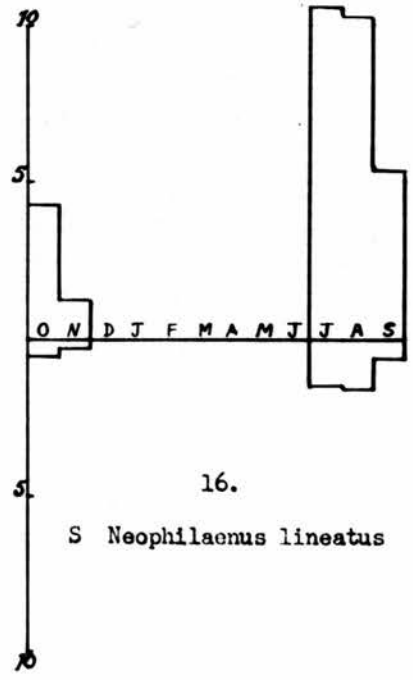
14.

B Limothrips cerealium



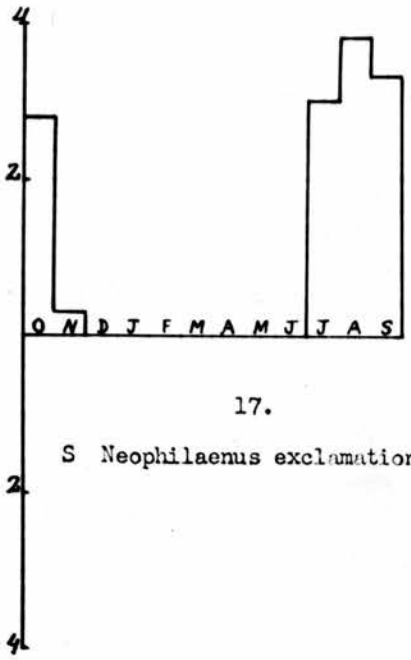
15.

T Thrips fuscipennis



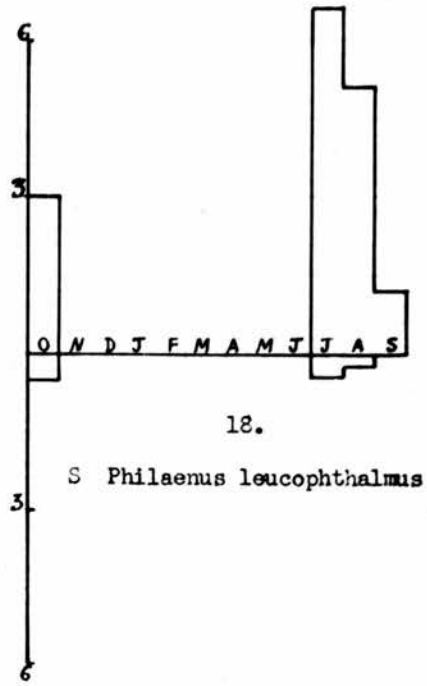
16.

S Neophilaenus lineatus



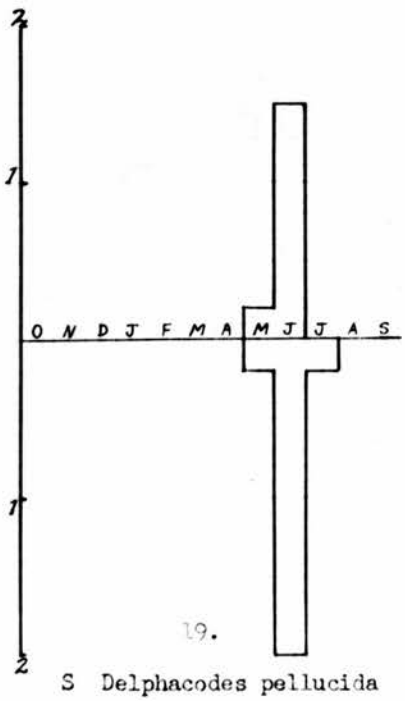
17.

S Neophilaenus exclamationis



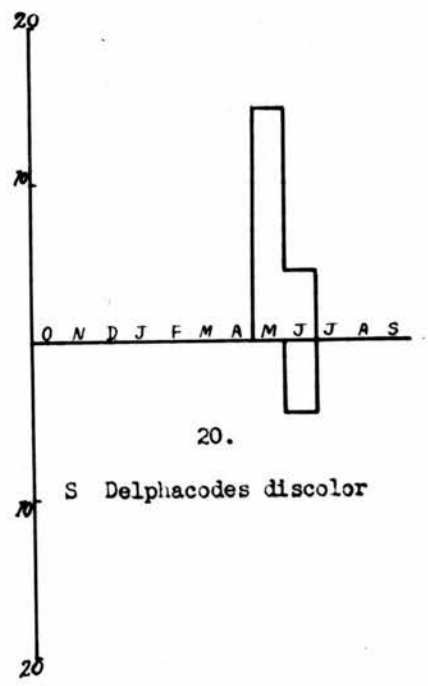
18.

S Philaenus leucophthalmus



19.

S Delphacodes pellucida



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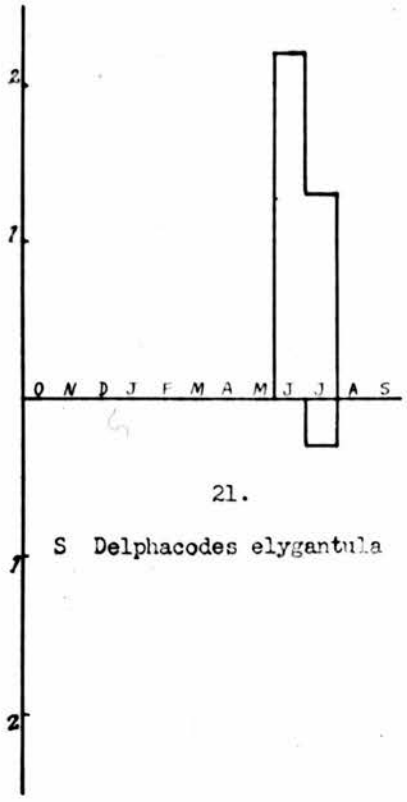
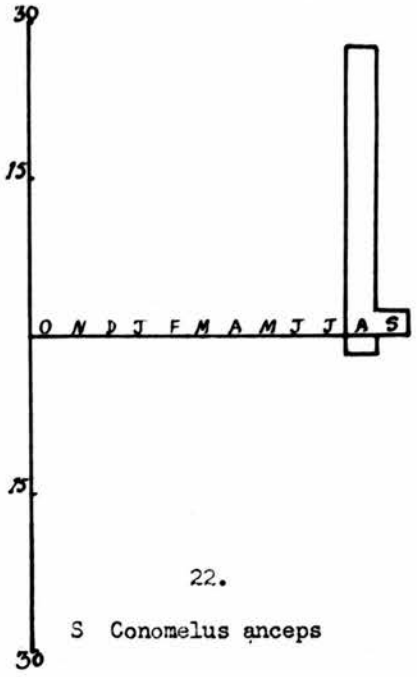
S Delphacodes discolor



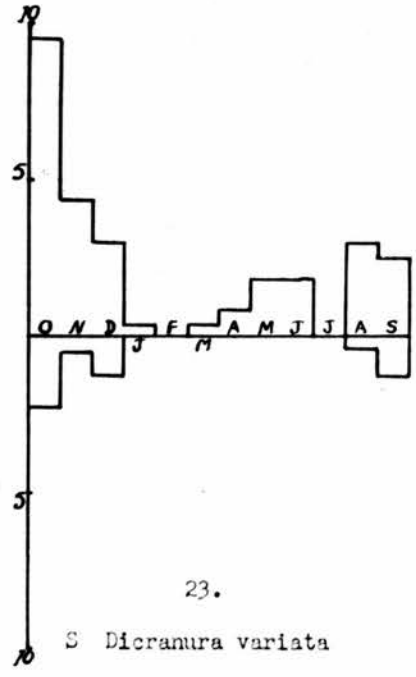
21.

S Delphacodes elygantula



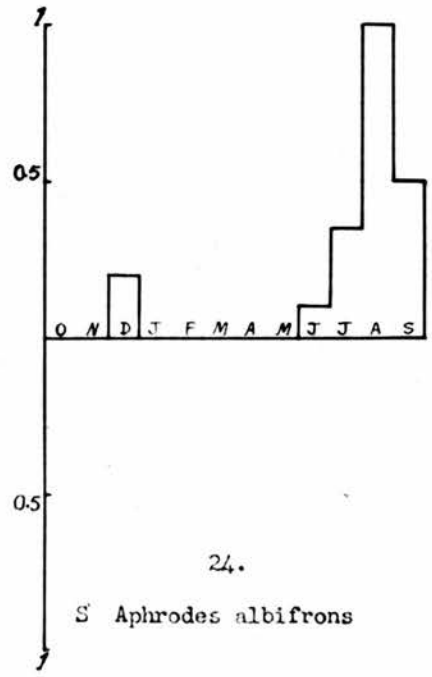
22.

S Conomelus anceps



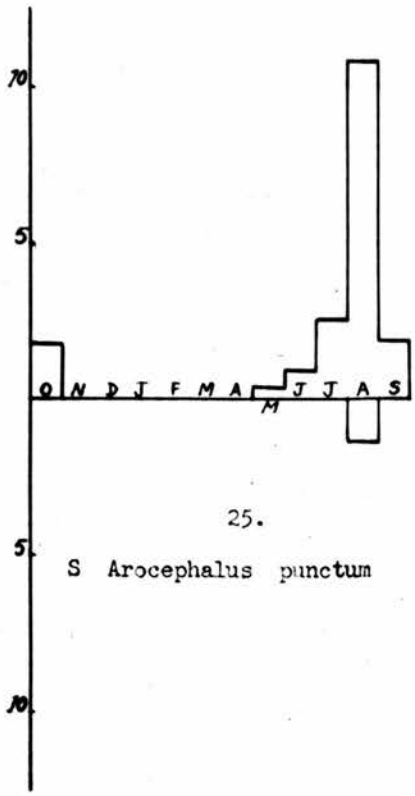
23.

S Dicranura variata



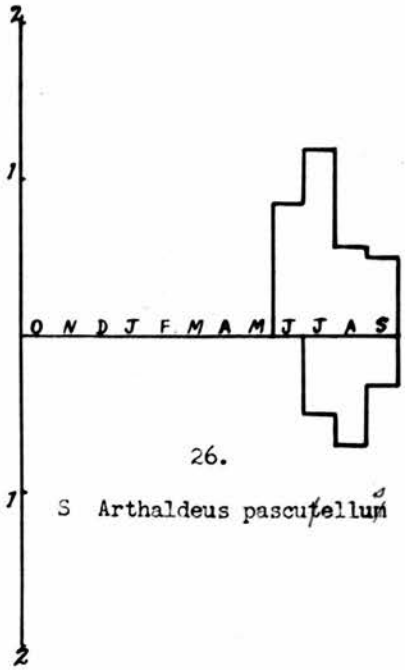
24.

S Aphrodes albifrons



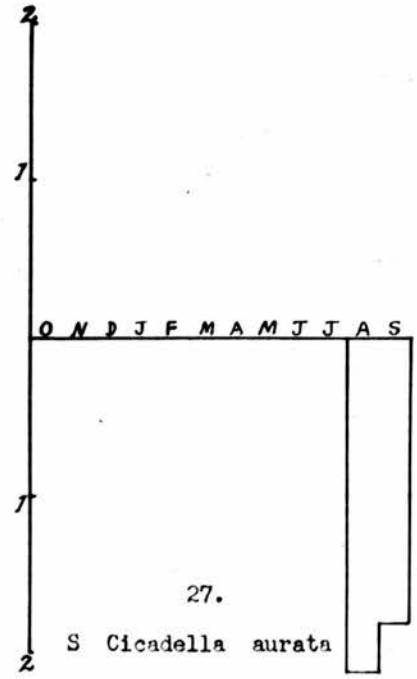
25.

S Arocephalus punctum



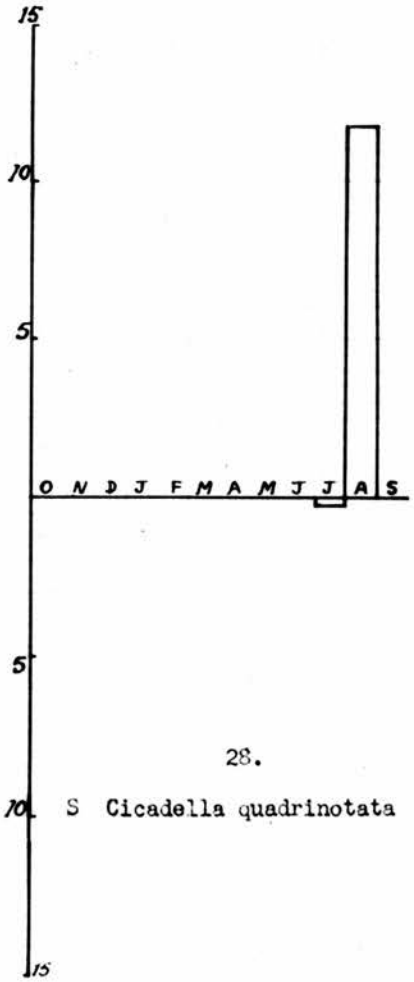
26.

S Arthaldeus pascuellum



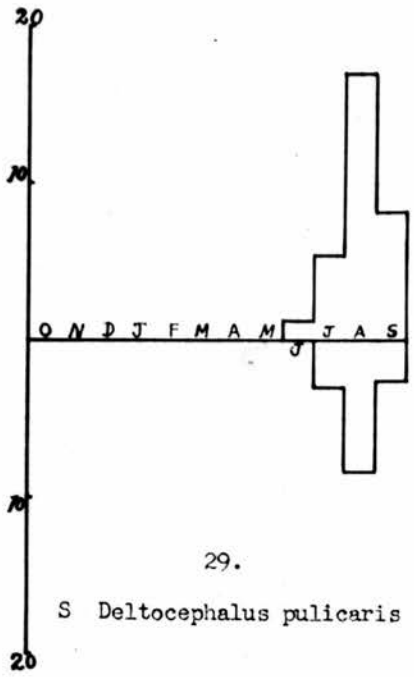
27.

S Cicadella aurata



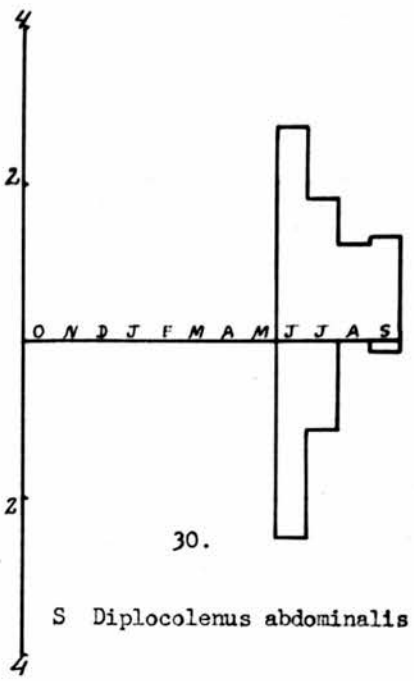
28.

S Cicadella quadrinotata



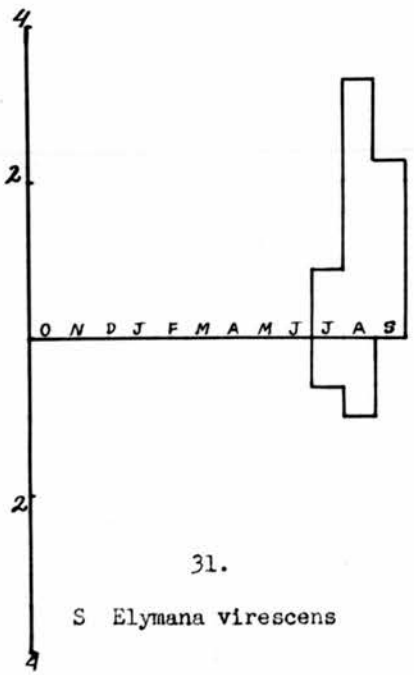
29.

S Deltocephalus pulicaris



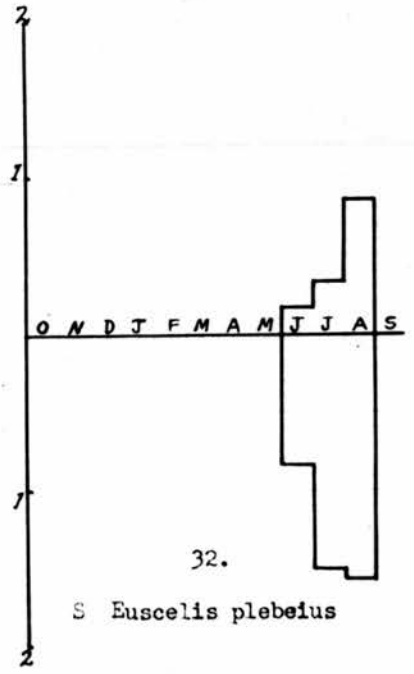
30.

S Diplocolenus abdominalis



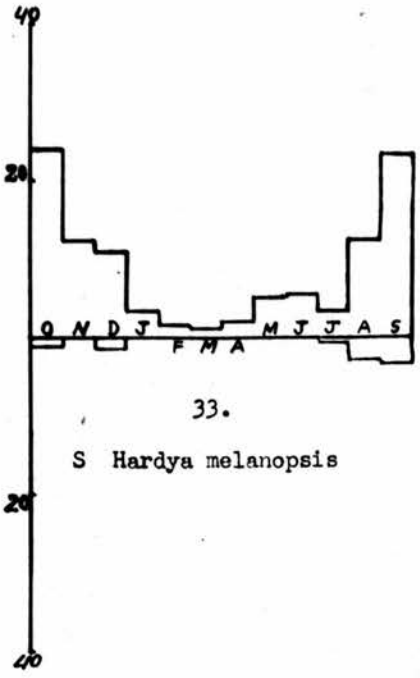
31.

S Elymana virescens



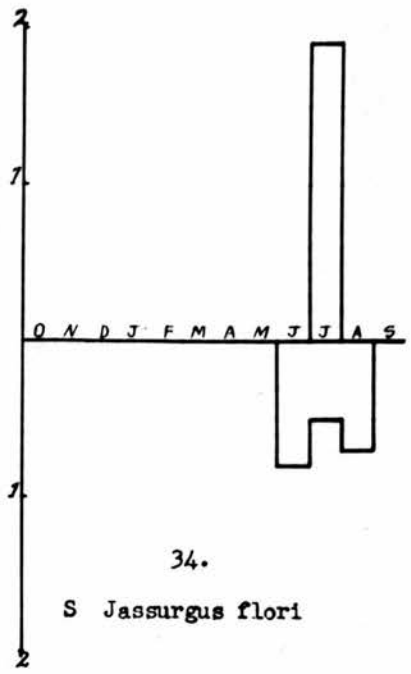
32.

S Euscelis plebeius



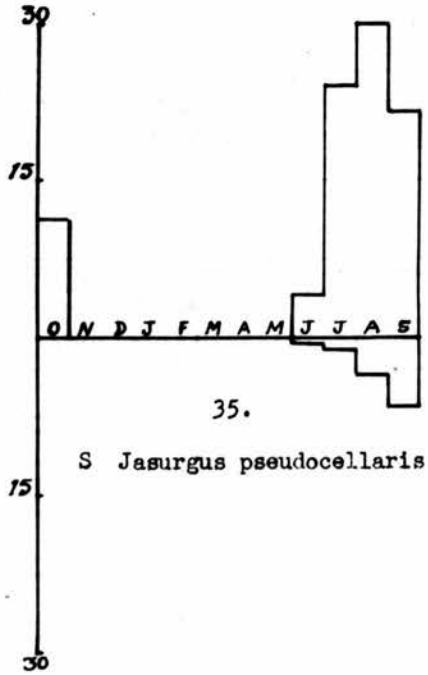
33.

S Hardya melanopsis



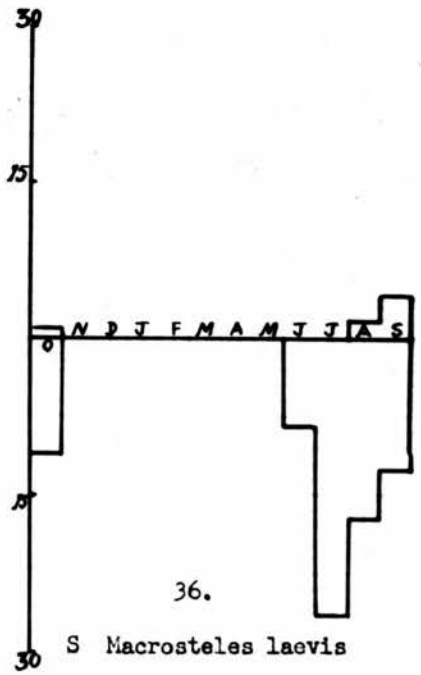
34.

S Jassurgus flori



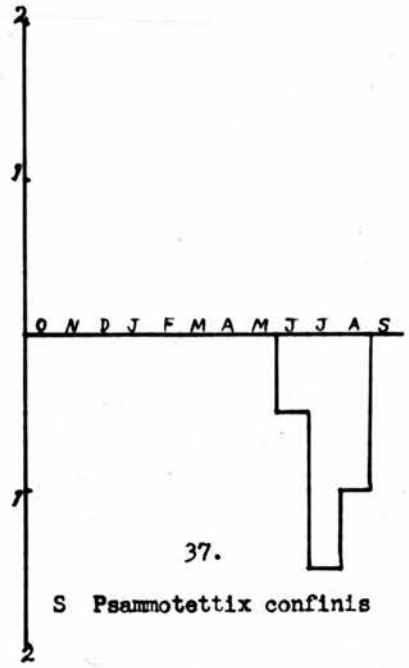
35.

S Jasurgus pseudocellaris



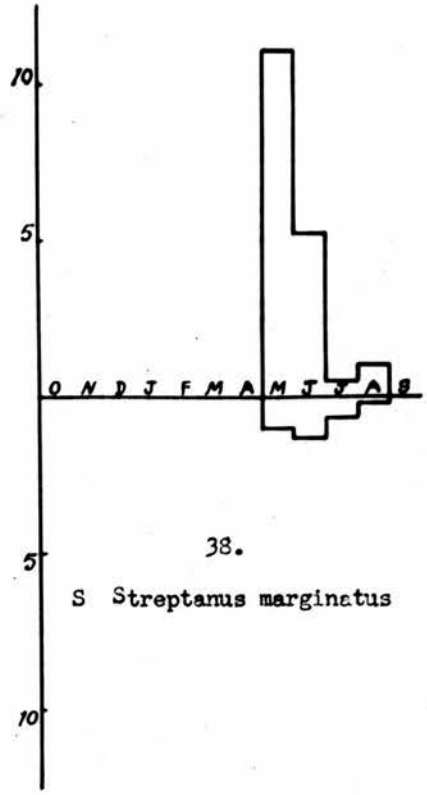
36.

S Macrosteles laevis



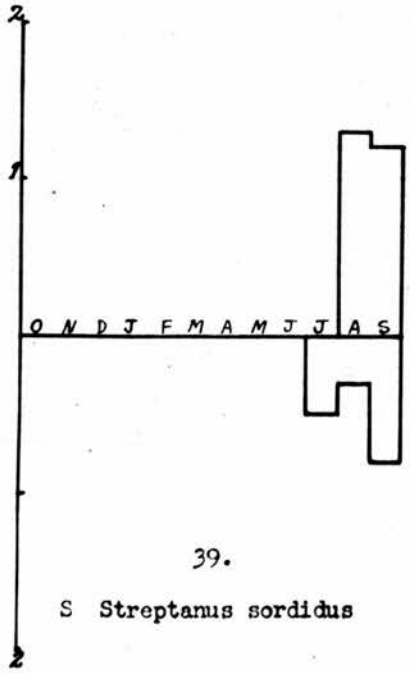
37.

S **Psammotettix confinis**



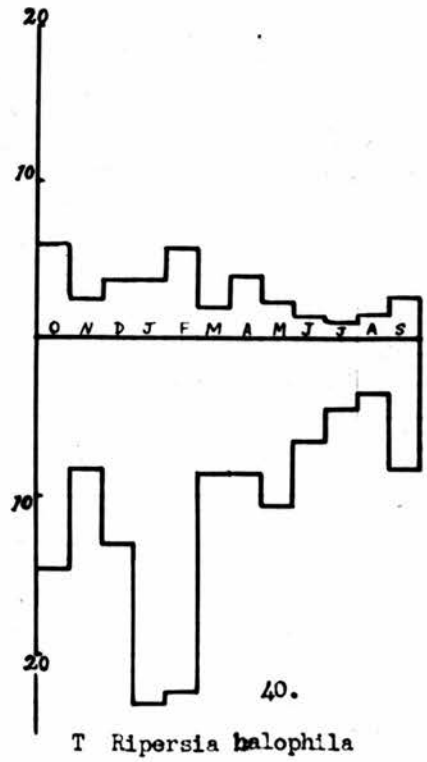
38.

S Streptanus marginatus



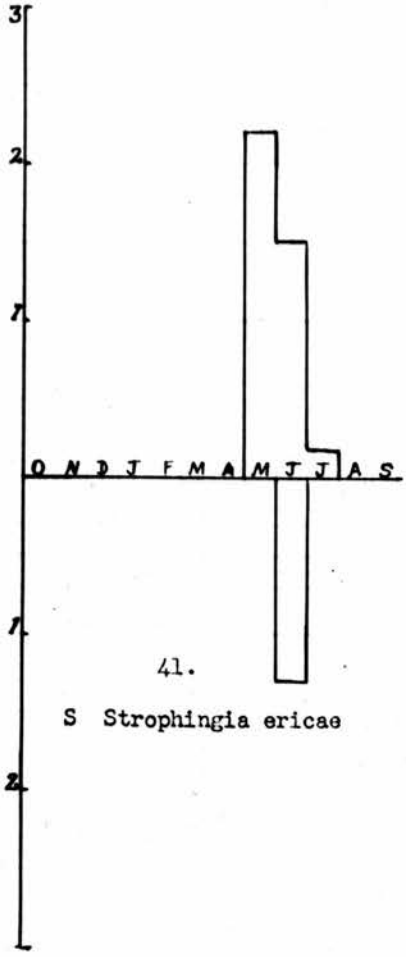
39.

S Streptanus sordidus



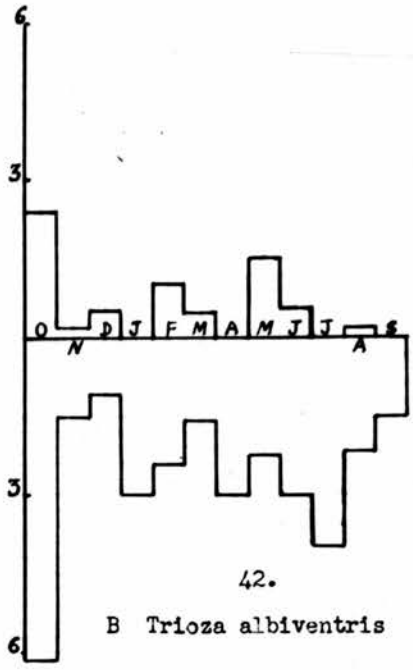
40.

T Ripersia halophila



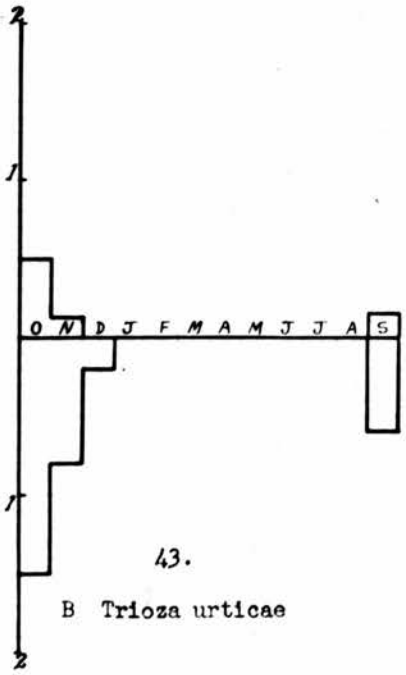
41.

S Strophingia ericae



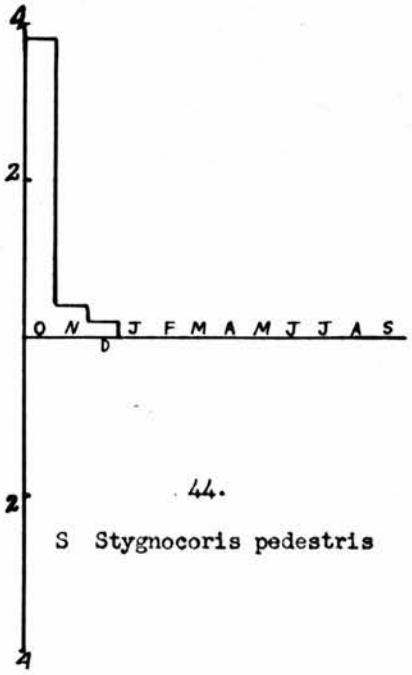
42.

B Trioza albiventris



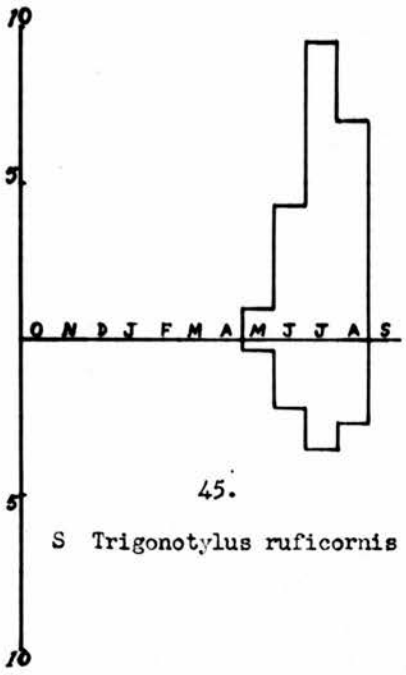
43.

B Trioza urticae



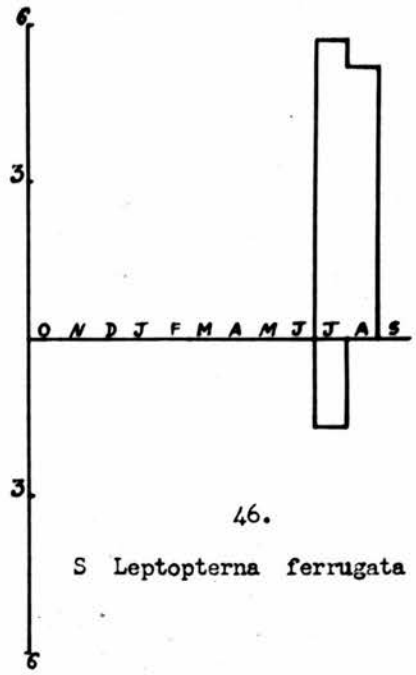
44.

S Stygnocoris pedestris



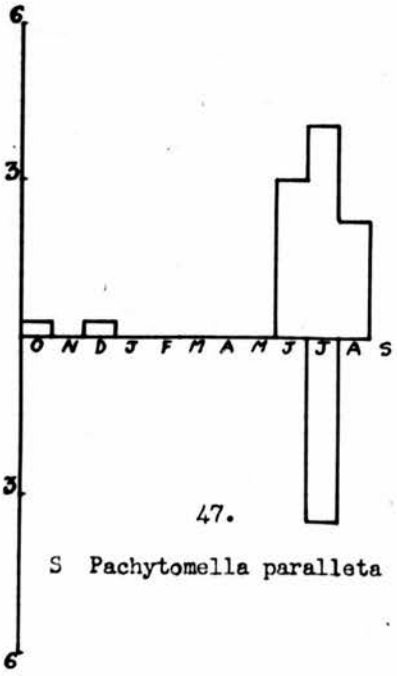
45.

S Trigonotylus ruficornis



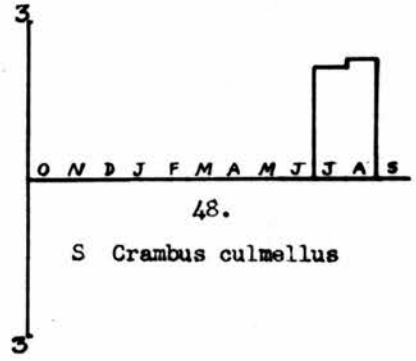
46.

S Leptopterna ferrugata



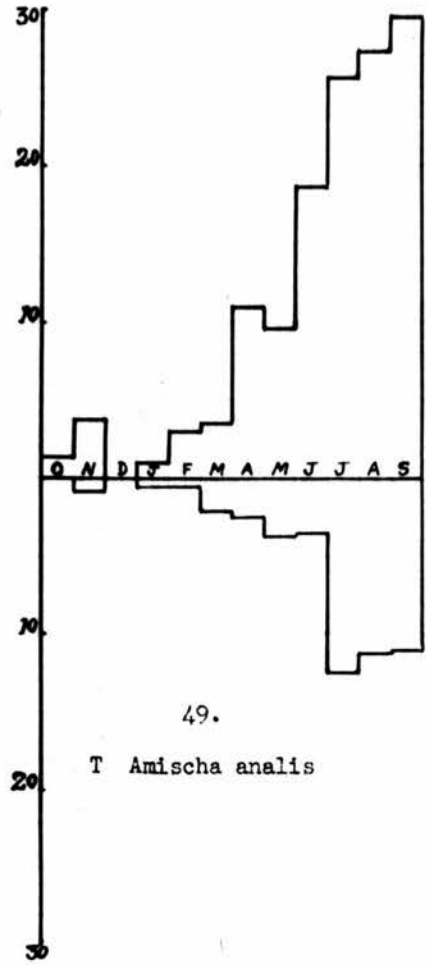
47.

S Pachytomella paralleta



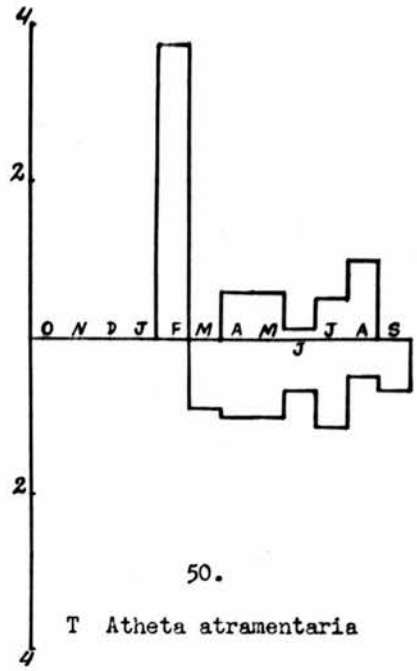
48.

S Crambus culmellus



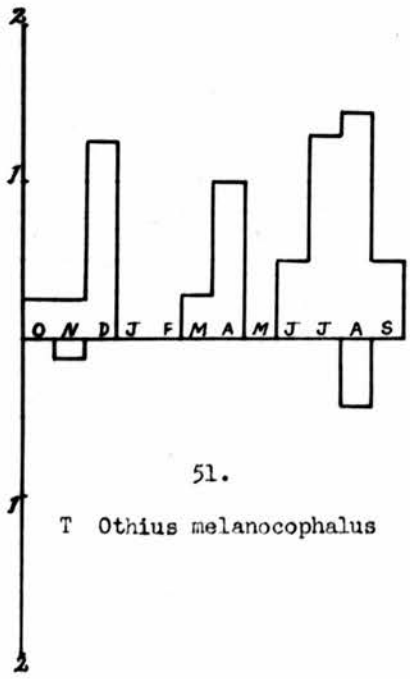
49.

T Amischa analis



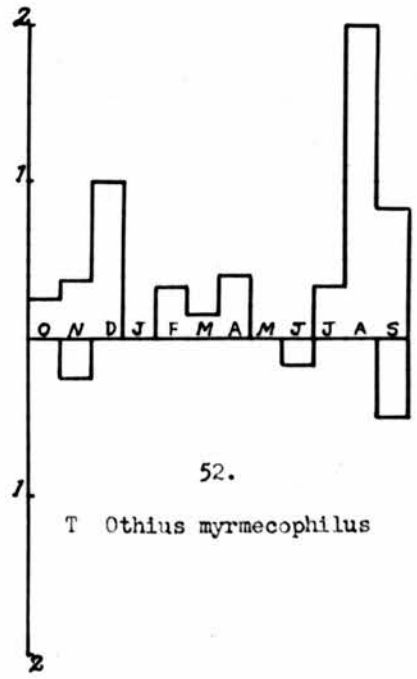
50.

T Atheta atramentaria



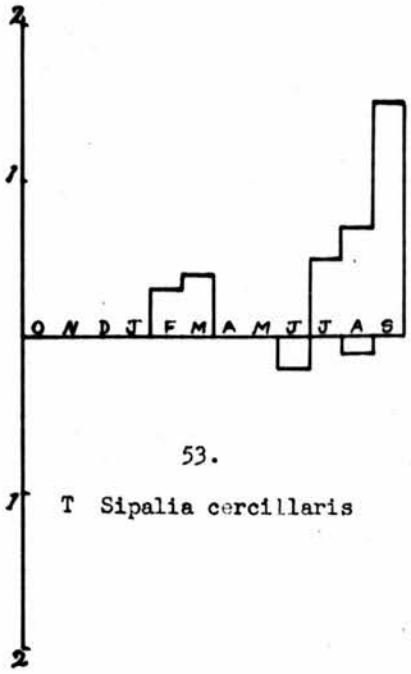
51.

T Othius melanocophalus



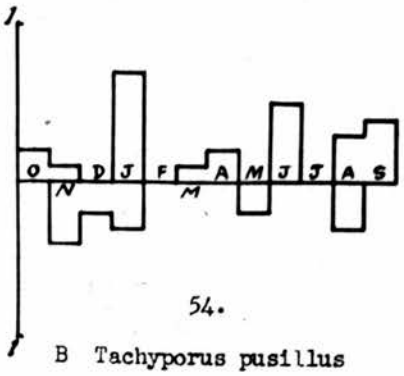
52.

T Othius myrmecophilus



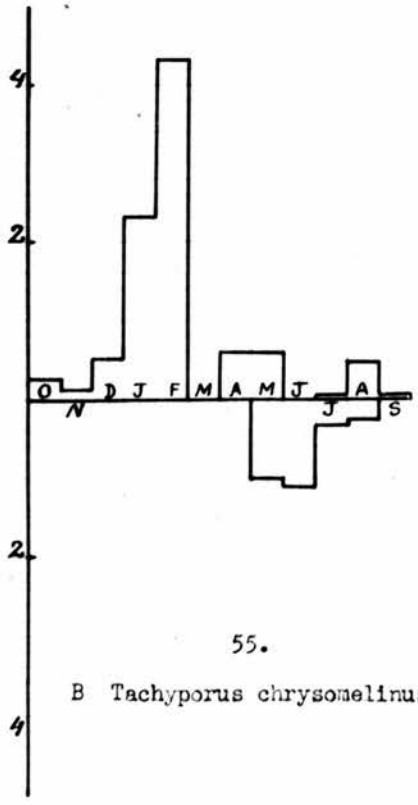
53.

T Sipalia cercillaris



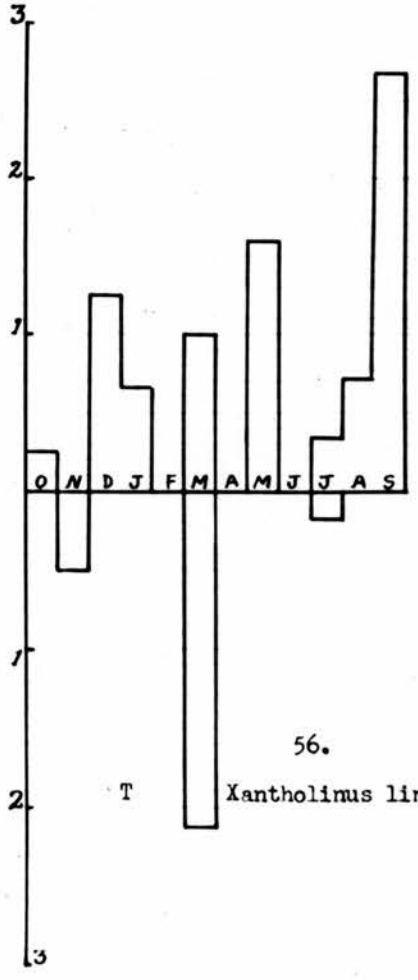
54.

B Tachyporus pusillus



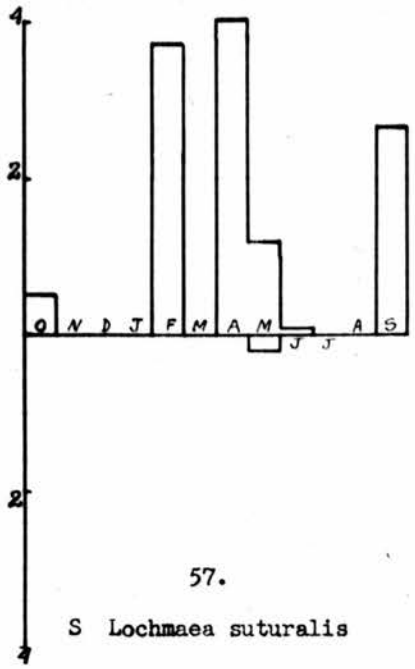
55.

B Tachyporus chrysomelinus



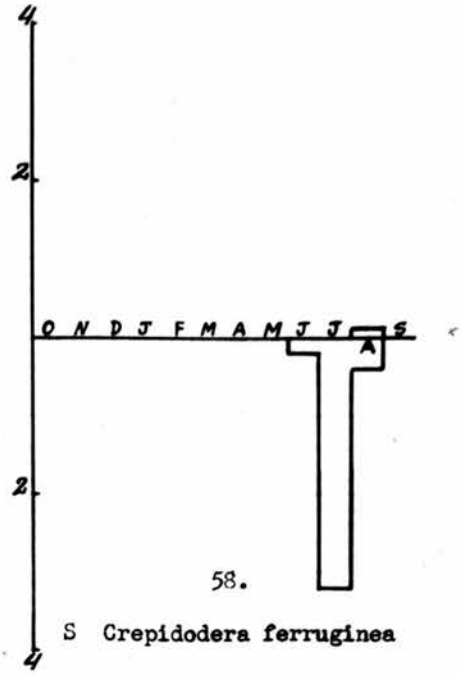
56.

T Xantholinus linearis



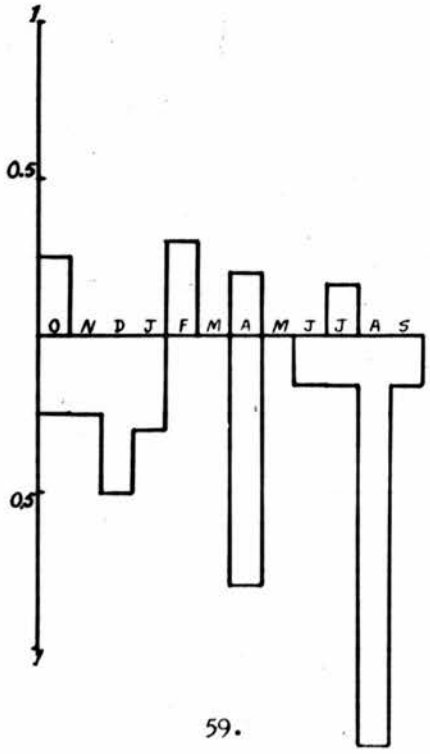
57.

S Lochmaea suturalis



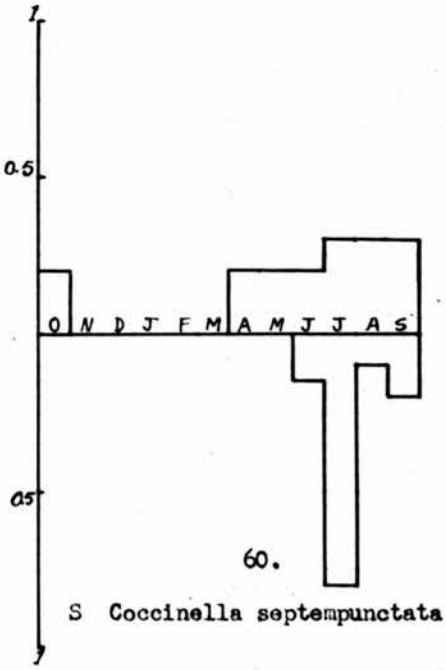
58.

S Crepidodera ferruginea



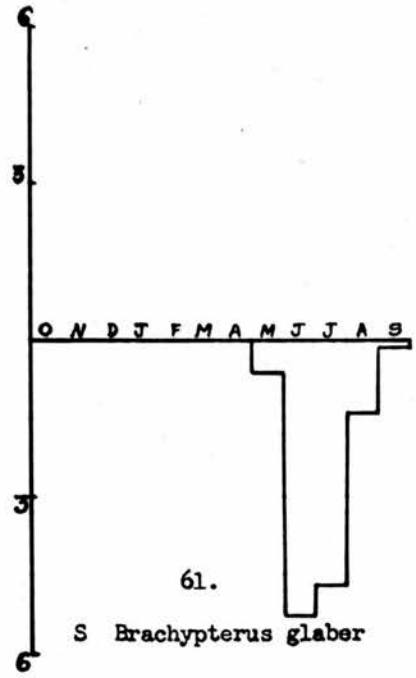
59.

B Hegisternum obscurum



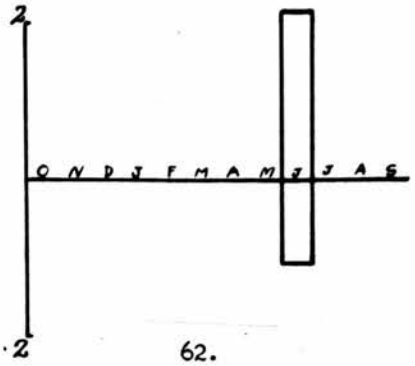
60.

S Coccinella septempunctata



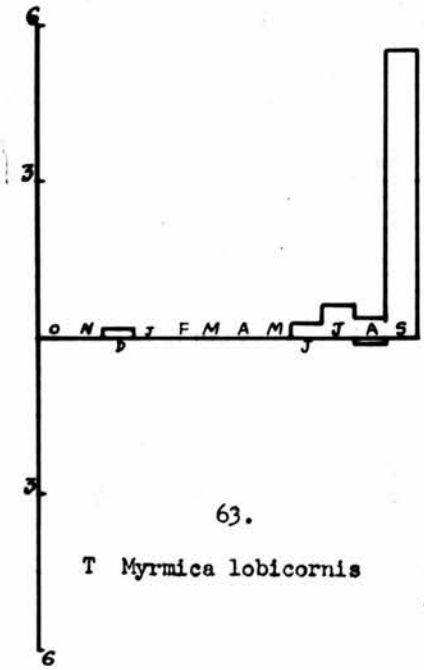
61.

S Brachypterus glaber



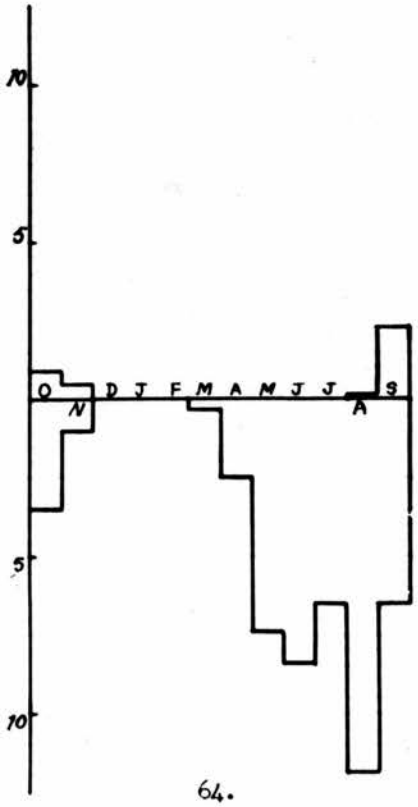
62.

S Rhagonycha limbata



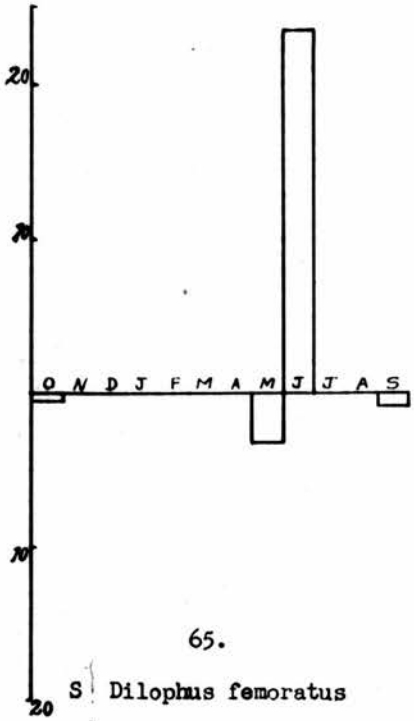
63.

T Myrmica lobicornis



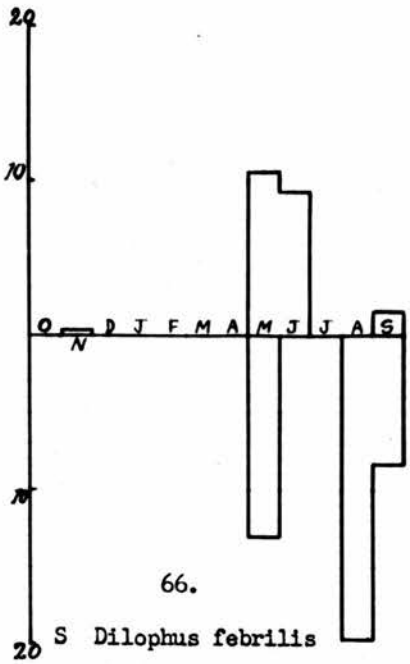
64.

S Lonchoptera furcata



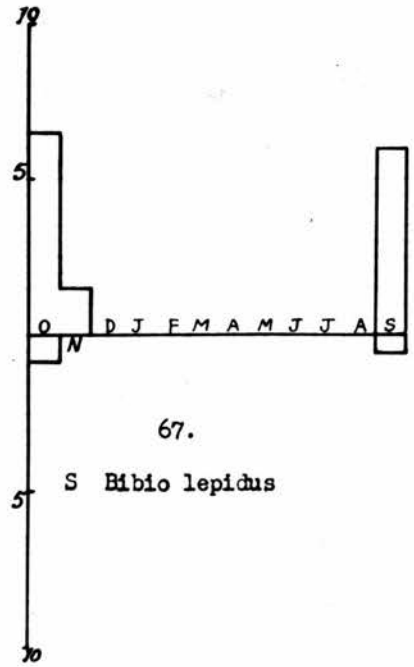
65.

S Dilophus femoratus



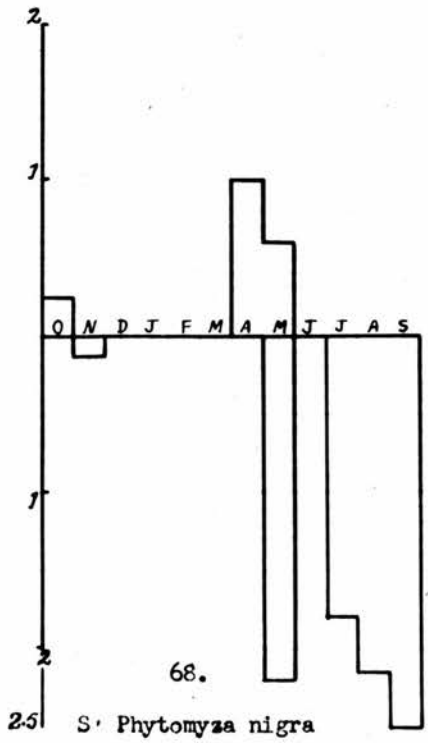
66.

S Dilophus febrilis



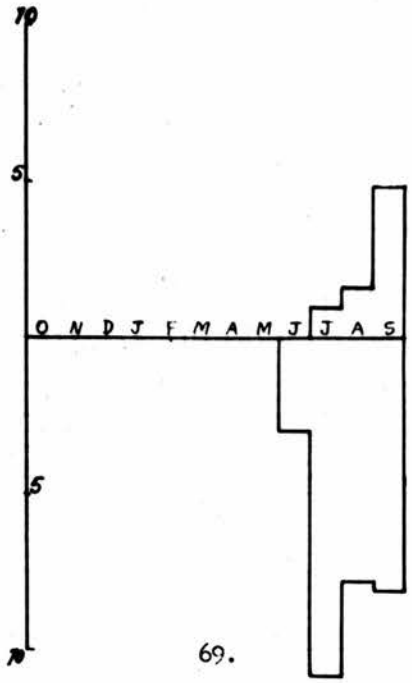
67.

S Bibio lepidus



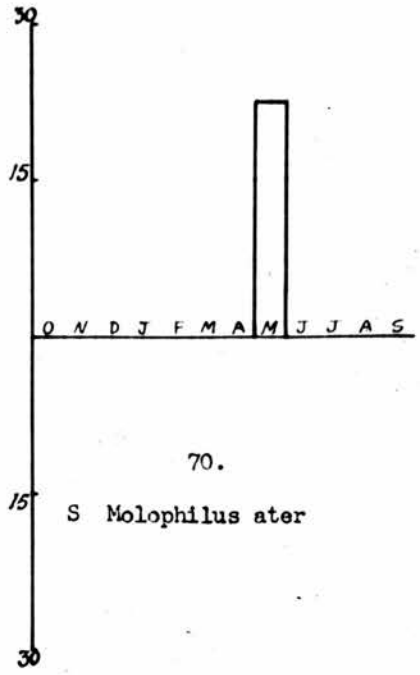
68.

S. Phytomyza nigra



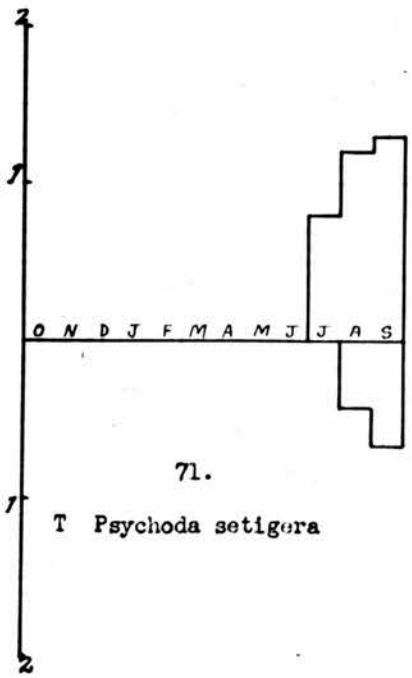
69.

S Cerodonta denticornis



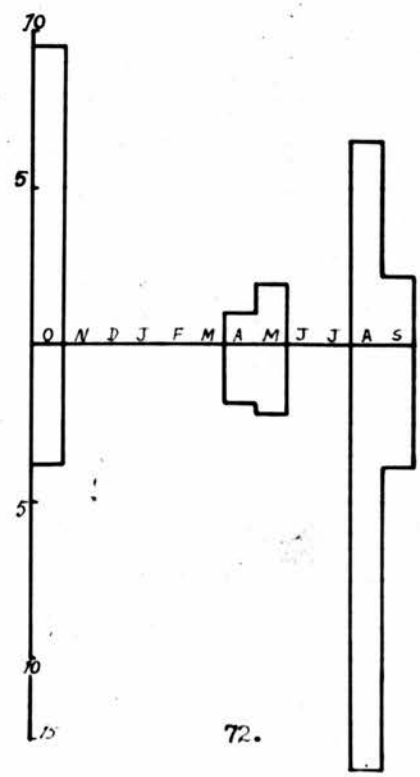
70.

S Molophilus ater



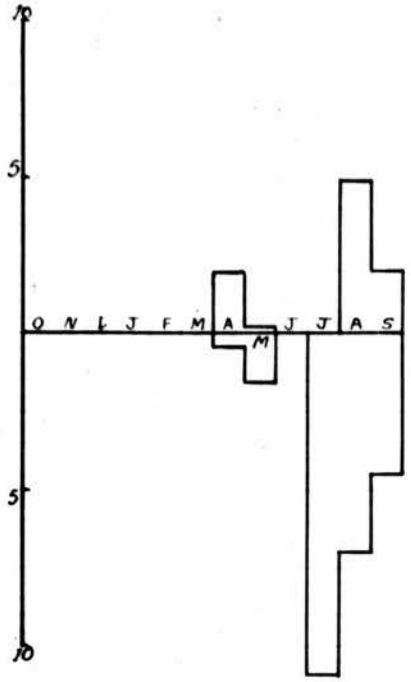
71.

T Psychoda setigera



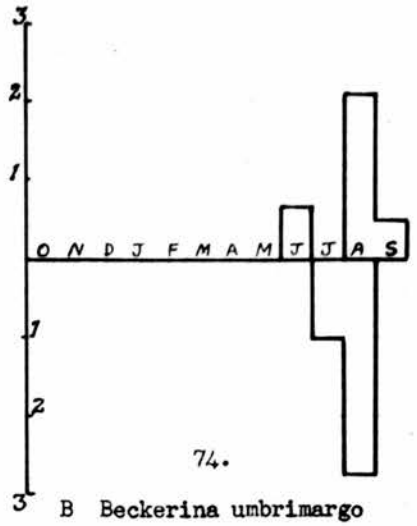
72.

B Sciara quinquelineata



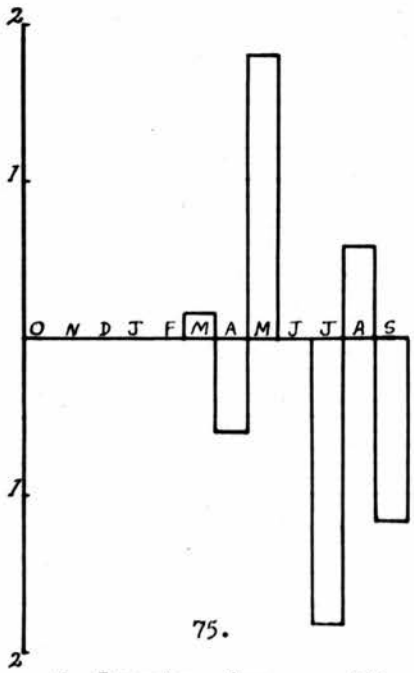
73

B Sciara autumnalis



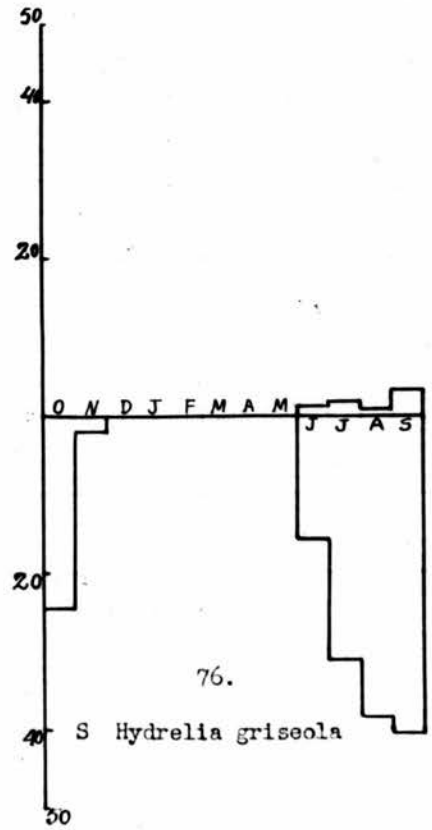
74.

B Beckerina umbrimargo



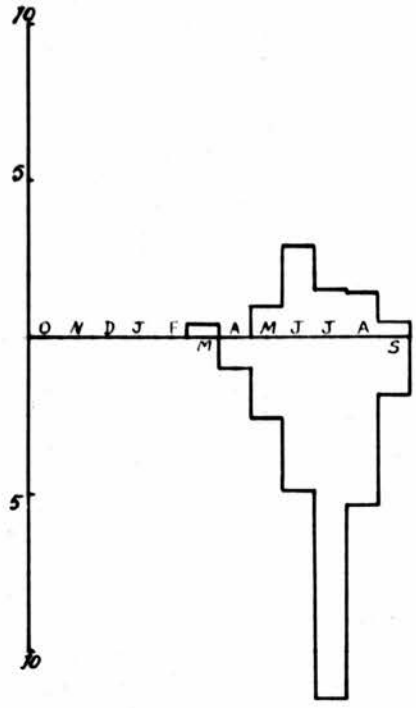
75.

S Parastenophora gracilis



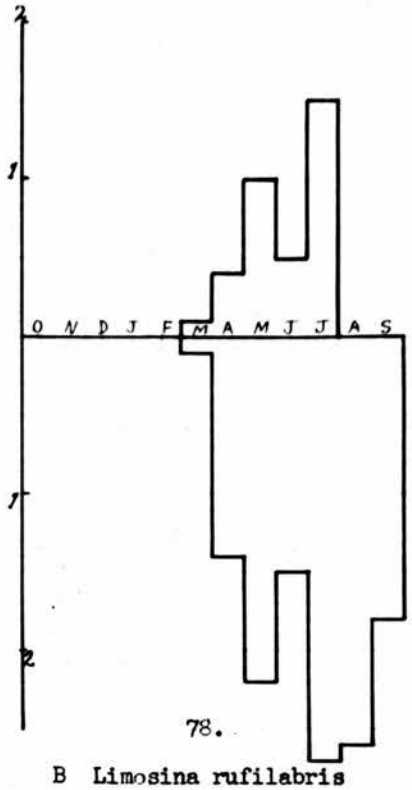
76.

S Hydrelia griseola



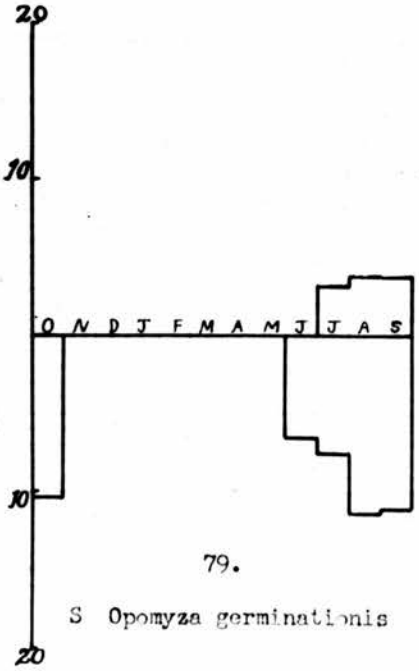
77.

B Borborus hirtipes



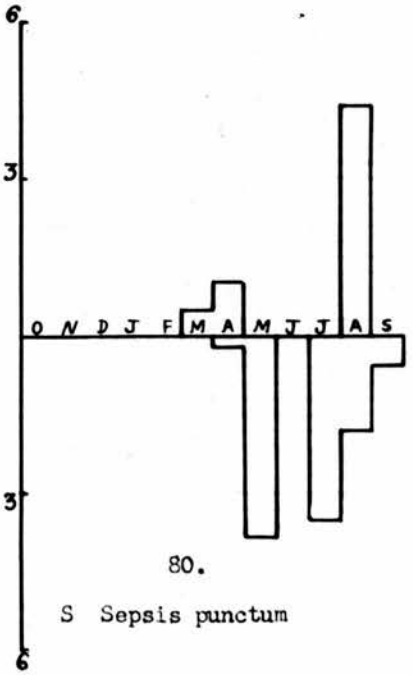
78.

B Limosina rufilabris



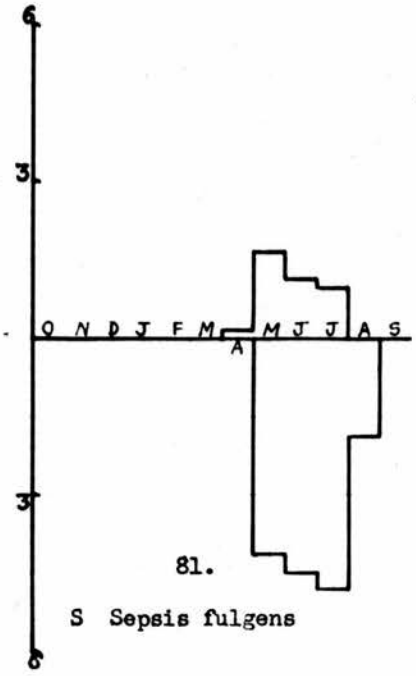
79.

S Opomyza germinationis



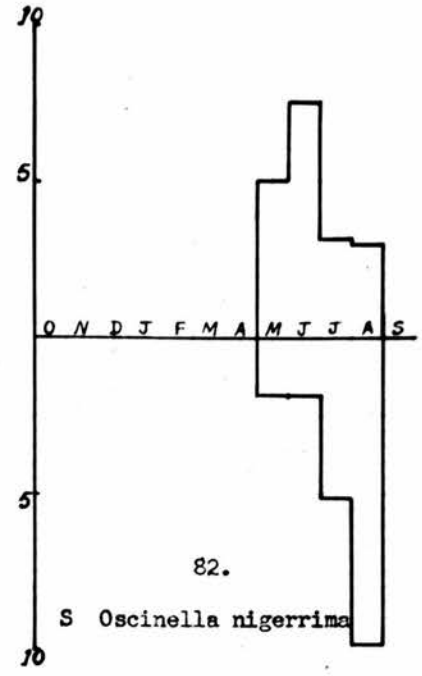
80.

S Sepsis punctum



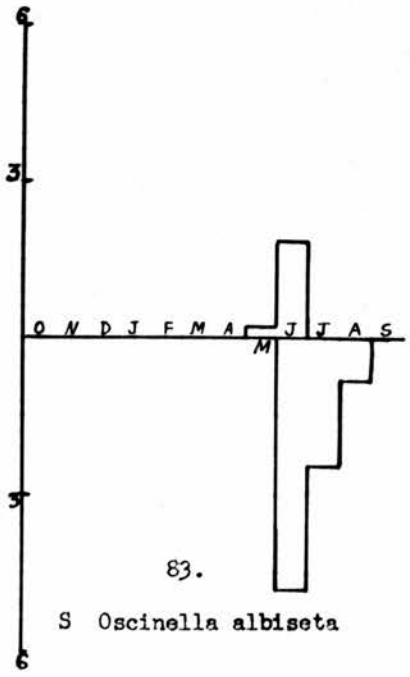
81.

S Sepsis fulgens



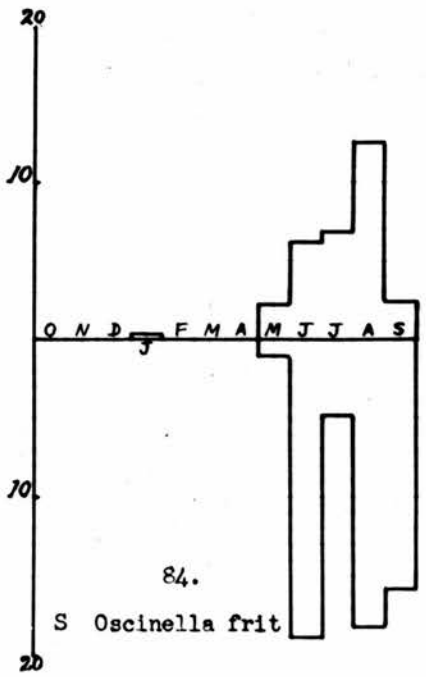
82.

S Oscinella nigerrima



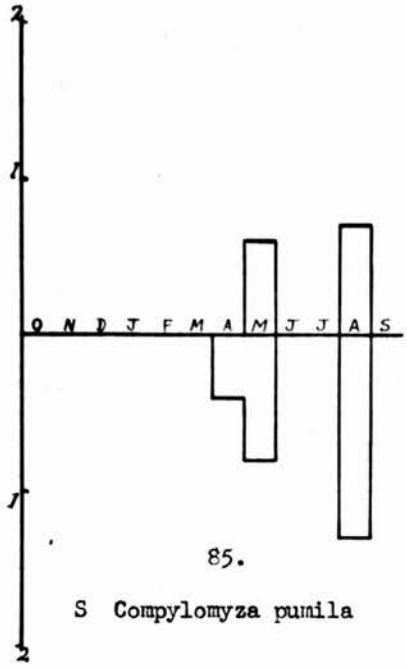
83.

S Oscinella albiseta



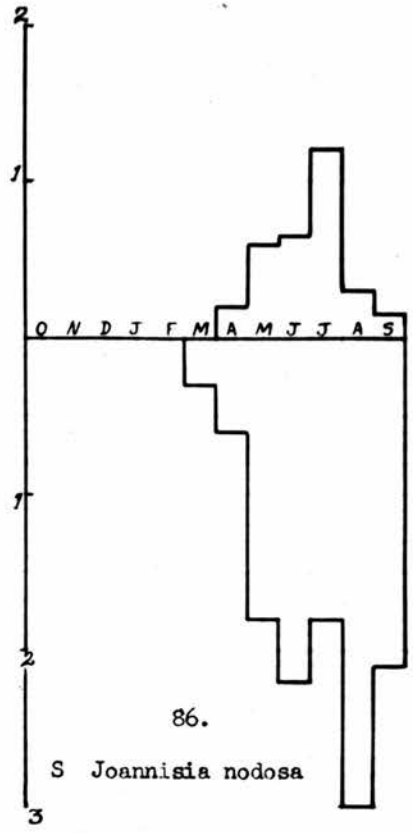
84.

S Oscinella frit



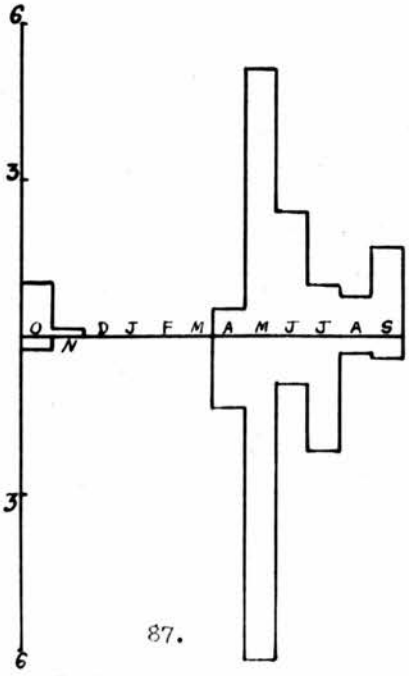
85.

S Compylomyza pumila



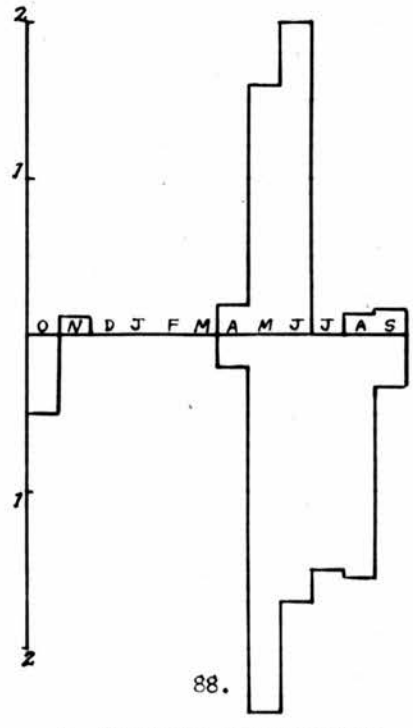
86.

S Joannisia nodosa



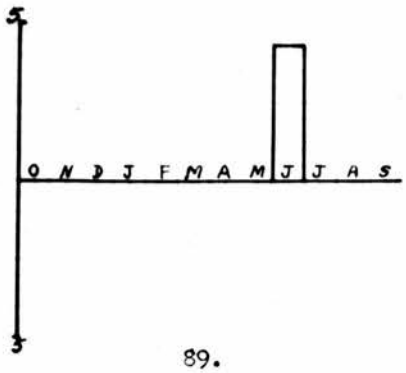
87.

S Hylemyia variata



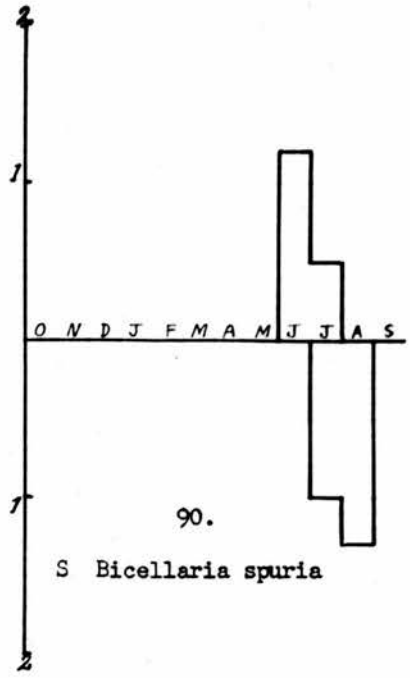
88.

S Scopeuma stercorarium



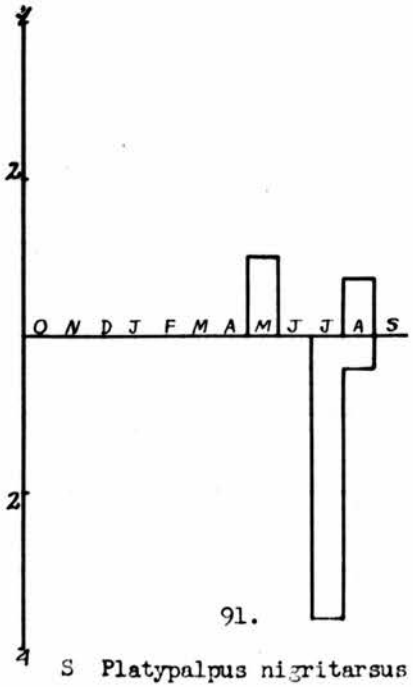
89.

S Bicellaria pilosa



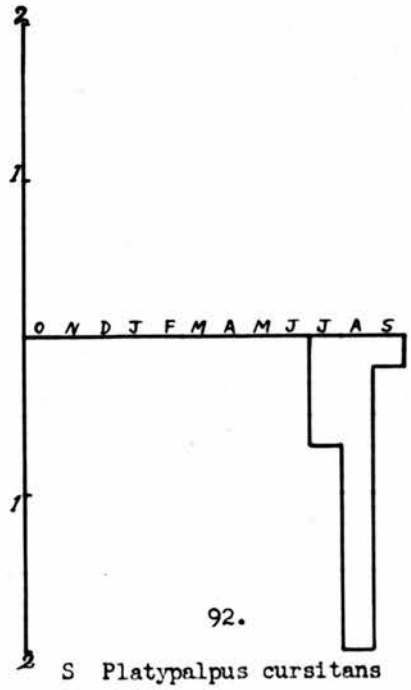
90.

S Bicellaria spuria



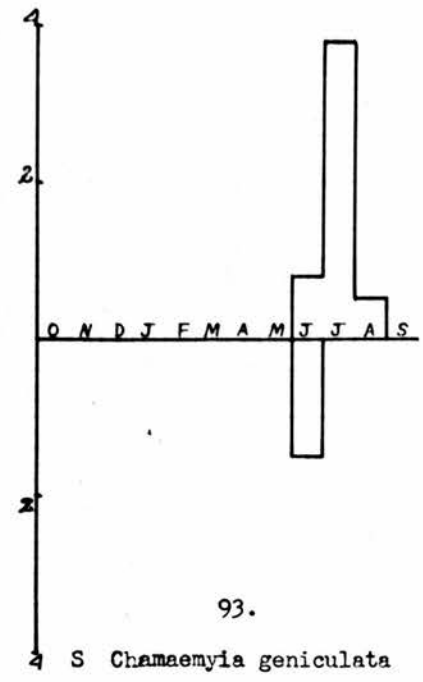
91.

S Platypalpus nigritarsus



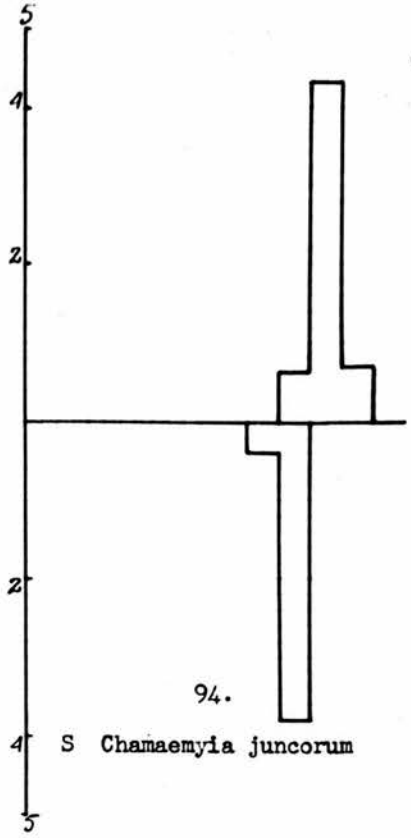
92.

S Platypalpus cursitans



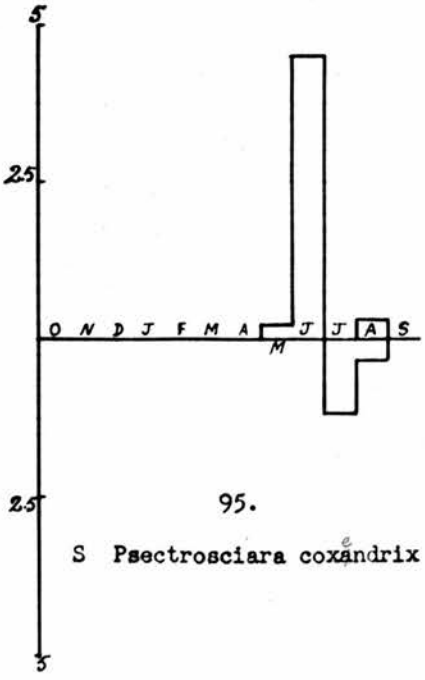
93.

S Chamaemyia geniculata



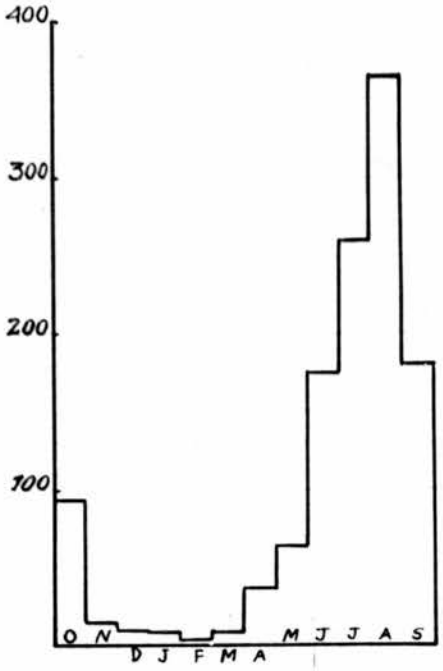
94.

S Chamaemyia juncorum



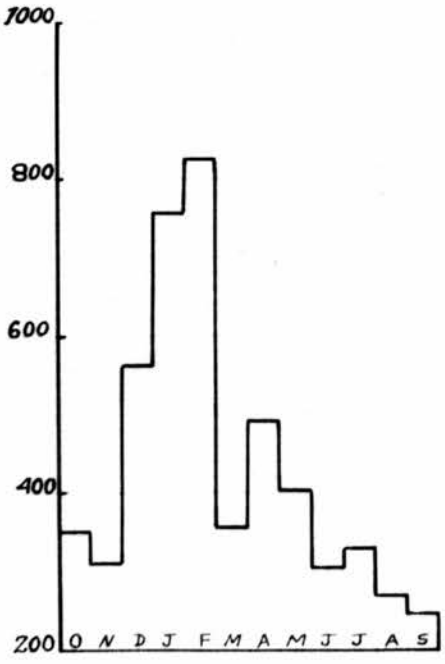
95.

S Psectrosciara coxandrix



96.

Average number of insects per sweep-net sample during each month.



97.

Average number of insects per turf sample during each month.

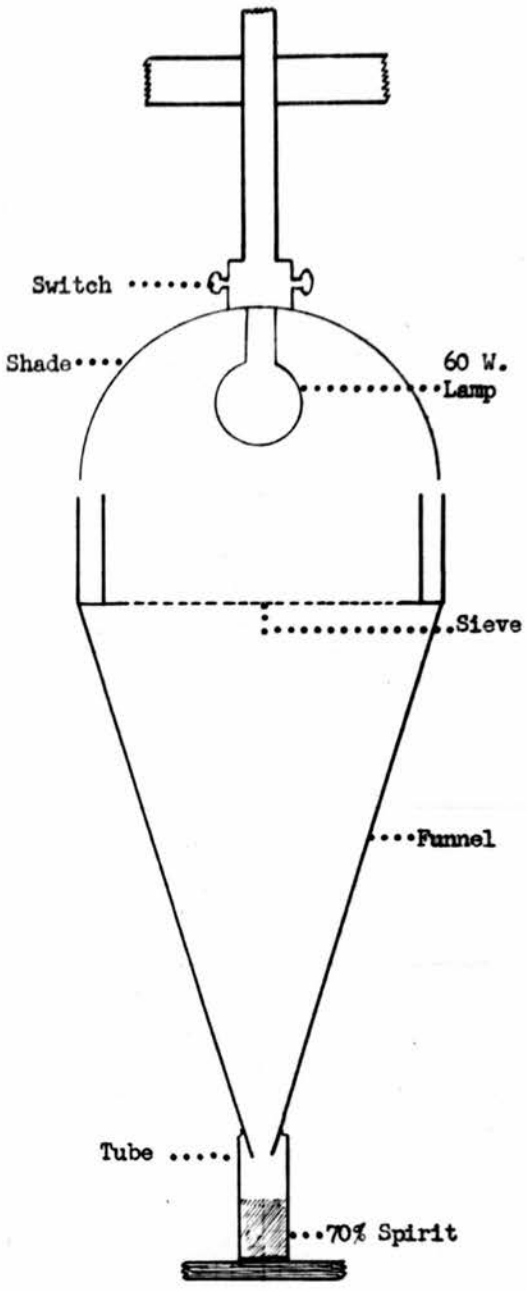


Diagram A.

Gifford's Modification of Tullgren's Apparatus.

Scale of inches.